CD-II MAX

TK 51120-1-MM (Rev. 0, 01/01)

The maintenance information in this manual covers unit models:	
CD-II MAX 30 NAD (919060)	**CD-II MAX 30 EEC (919064)**
CD-II MAX 50 NAD 230/1/60 (919061)	**CD-II MAX 50 230/1/60 EEC (919065)**
CD-II MAX 50 NAD 230/3/60 (919062)	**CD-II MAX 50 220/3/50 EEC (919066)**
CD-II MAX 50 NAD 380-460/3/50-6 (919063)	**CD-II MAX 50 380/3/50 EEC (919067)**
For further information, refer to…	
CD-II MAX Parts Manual	**TK 51153**
Operator's Manual	**TK 51111**
Diagnosing Thermo King Refrigeration Systems	**TK 5984**
Tool Catalog	**TK 5955**

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.

This manual is published for informational purposes only and the information so provided should not be considered as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation should be consulted.

Sale of product shown in this manual is subject to Thermo King's terms and conditions including, but not limited to, the Thermo King Limited Express Warranty. Such terms and conditions are available upon request.

Thermo King's warranty will not apply to any equipment which has been "so repaired or altered outside the manufacturer's plants as, in the manufacturer's judgment, to effect its stability."

No warranties, express or implied, including warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations, and descriptions contained herein. Manufacturer is not responsible and will not be held liable in contract or in tort (including negligence) for any special, indirect or consequential damages, including injury or damage caused to vehicles, contents or persons, by reason of the installation of any Thermo King product or its mechanical failure.

Recover Refrigerant

At Thermo King, we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

In addition, service personnel must be aware of Federal regulations concerning the use of refrigerants and the certification of technicians. For additional information on regulations and technician certification programs, contact your local THERMO KING dealer.

NOTE: Because of the many variables in oils, particularly in HVAC systems, Zexel, ICE, Bock and Alma A6 compressors may be delivered with an oil that is not specified for the particular unit it is to be fitted to. Unless it is 100% clear it is the correct oil, Thermo King recommends the oil is changed to the correct type.

CAUTION: With HVAC systems and the use of PAG, it is very important that oil mixing does not take place. PAG and POE oil CANNOT be mixed. Mixing these oils will cause serious system contamination, especially with chlorine based refrigerants.

NOTE: The proper compressor oil is determined by the refrigerant used and specific air conditioning application requirements. Verify both serial nameplates on the unit and compressor for correct oil to use in a particular system. DO NOT mix PAG and POE oils.

CAUTION: All Thermo King systems must be properly labeled with the refrigerant and oil that is used in that system. If this is not done, and the wrong oils/refrigerants are mixed, damage to the system will result.

CAUTION: Units containing R-134a require dedicated refrigeration equipment and special maintenance practices. Read the section "Refrigerant R-134a for Bus Applications" in the Safety Precautions Chapter before performing any maintenance procedures.

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Safety Precautions

GENERAL PRACTICES

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid, refrigeration oil, and battery acid can permanently damage the eyes (see First Aid).
2. Never operate the unit with the compressor discharge service valve closed.
3. Keep your hands, clothing and tools clear of the fans and belts when the unit is running. This should also be considered when opening and closing the compressor service valves.
4. Make sure gauge manifold hoses are in good condition. Never let them come in contact with a belt, fan motor pulley, or any hot surface.
5. Never apply heat to a sealed refrigeration system or container.
6. Fluorocarbon refrigerants in the presence of an open flame produce toxic gases that are severe respiratory irritants capable of causing death.
7. Make sure all mounting bolts are tight and are of correct length for their particular application.
8. Use extreme caution when drilling holes in the unit. The holes may weaken structural components, and holes drilled into electrical wiring can cause fire or explosion. Holes drilled into the refrigeration system will release refrigerant.
9. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
10. Use caution when working with a refrigerant or refrigeration system in any closed or confined area with a limited air supply (for example, a truck body or garage). Refrigerant tends to displace air and can cause oxygen depletion resulting in suffocation and possible death.
11. When using ladder or scaffolding, use caution and follow manufacturer recommendations.

AUTO START/STOP

CAUTION: The unit may start automatically and at any time when the unit ON/OFF switch is in the ON position. Units with the CYCLE-SENTRY option start automatically in both CYCLE-SENTRY mode and Continuous mode. Be sure to turn the ON/OFF switch off before opening doors or inspecting or working on any part of the unit.

REFRIGERANT

When removing refrigerant from a unit, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law.

When a refrigerant is exposed to the atmosphere in the liquid state, it evaporates rapidly, freezing anything it contacts. If refrigerant contacts the skin, severe frost bite can result.

First Aid

In the event of frost bite, the objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly and to maintain respiration.

- EYES: For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- SKIN: Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- INHALATION: Move victim to fresh air and use cardiopulmonary resuscitation (CPR) or mouth-to-mouth ventilation if necessary. Stay with victim until arrival of emergency medical personnel.

REFRIGERATION OIL

Observe the following precautions when working with or around synthetic or polyol ester refrigerant oil:

- Do not allow refrigerant oil to contact your eyes.
- Do not allow prolonged or repeated contact with skin or clothing.
- To prevent irritation, you should wash thoroughly immediately after handling refrigerant oil. Rubber gloves are recommended when handling polyol ester oil.

First Aid

- EYES: Immediately flush eyes with large amounts of water for at least 15 minutes while holding the eyelids open. Get prompt medical attention.
- SKIN: Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- INHALATION: Move victim to fresh air and restore breathing if necessary. Stay with victim until arrival of emergency personnel.
- INGESTION: Do not induce vomiting. Contact a local poison control center or physician immediately.

ELECTRICAL HAZARDS

Microprocessor Service

Precautions must be taken to prevent electrostatic discharge when servicing the microprocessor controller and related components. Potential differences considerably lower than those which produce a small spark from a finger to a door knob can severely damage or destroy solid-state integrated circuit components.

The following procedures must be rigidly adhered to when servicing units to avoid microprocessor damage or destruction.

1. Disconnect all power to the unit.
2. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
3. Do wear a static discharge wrist strap (P/N 204-622) with the lead end connected to the microprocessor's ground terminal. These straps are available at most electronic equipment distributors. DO NOT wear these straps with power applied to the unit.

   Refer to the THERMOGUARD µP-T Microprocessor Controller Operations and Diagnosis Manual (TK 41087) (T.I.P. Procedure #P41AA12B) and the Electrostatic Discharge Training Guide (TK 40282) for additional information.
4. Avoid contacting the electronic components on the circuit boards of the unit being serviced.
5. Leave the circuit boards in their static proof packing materials until ready for installation.
6. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
7. After servicing the controller or any other circuits, the wiring should be checked for possible errors before restoring power.
8. Never use testers consisting of a battery and a light bulb to test circuits on any microprocessor based equipment.
9. Before connecting or disconnecting the battery, the microprocessor switch must be turned off.

NOTE: The following T.I.P. Procedures may be found in Operation and Diagnosis Manual TK 41087.

- Replacing and calibrating the return air and discharge sensor.
- Replacing the µP-T microprocessor.
- Welding on the unit or truck.

Welding of Units or Truck Bodies

When electric welding is to be performed on any portion of the temperature control unit, truck or truck chassis when the temperature control unit is attached, it is necessary to ensure that welding currents are NOT allowed to flow through the electronic circuits of the unit.

These procedures must be rigidly adhered to when servicing units to avoid damage or destruction of the controller.

1. Disconnect all power to the unit.
2. Disconnect all wire harnesses from the controller.
3. Switch all of the electrical circuit breakers in the control box to the OFF position.
4. Weld unit and/or container per normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
5. When the welding operation is completed, the unit power cables, wiring and circuit breakers must be restored to their normal condition.

High Voltage

When servicing or repairing a temperature control unit, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with a refrigeration unit that is connected to a source of operating power, even if the unit is not operating. Lethal voltage potentials can exist at the unit power cord, inside the control box, at the motors and within the wiring harnesses.

Precautions

1. Be certain the unit ON/OFF switch is turned off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.
2. Be certain the unit power plug is clean and dry before connecting it to a power source.
3. When working on high voltage circuits on the temperature control unit, do not make any rapid moves. If a tool drops, do not grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
4. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
5. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
6. Never work alone on high voltage circuits on the temperature control unit. Another person should always be present to shut off the temperature control unit and to provide aid in the event of an accident.
7. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

IMMEDIATE action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance if available.

The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or by a rescuer wearing electrically insulated gloves and safety glasses. Whichever method is used do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim must be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. DO NOT TOUCH the victim. You can receive a shock from current flowing through the victim's body.

After separating the victim from the power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardiopulmonary Resuscitation) and call for emergency medical assistance. If a pulse is present, respiration may be restored by using mouth-to-mouth resuscitation, but call for emergency medical assistance.

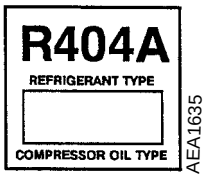
Low Voltage

Control circuits used in the temperature control unit are low voltage (24 volts ac and 12 volts dc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amps) can cause severe burns if shorted or ground.

Do not wear jewelry, watch or rings when working on the unit. If these items contact an electrical circuit, severe burns may result.

UNIT DECALS

Serial number decals, refrigerant type decals and warning decals appear on all Thermo King equipment. These decals provide information that may be needed to service or repair the unit. Service technicians should especially read and follow the instructions on all warning decals.



Refrigerant Decal

Specifications

ENGINE

Model		Thermo King TK 2.49
Fuel Type		**Use Diesel Fuel Only** No. 2 Diesel fuel under normal conditions No. 1 Diesel fuel is acceptable cold weather fuel
Oil Capacity: Crankcase & Oil Filter		3.0 quarts (2.8 liters) Fill to full mark on dipstick
Oil Type*	Mineral Oil	API Classification CF-4 or CG-4
	Synthetic Oil (After First 500 Hours)	API Classification CF-4 or CG-4
Oil Viscosity**		Multi-grade Oil Ambient Temperature F (C) SAE 15W-40 5 to 104 F (-15 to 40 C) SAE 10W-40 -4 to 104 F (-20 to 40 C) SAE 10W-30 -4 to 86 F (-20 to 30 C) SAE 5W-30 -22 to 86 F (-30 to 30 C)
Engine rpm:	Low Speed Operation	1550 to 1650 rpm
	High Speed Operation	2350 to 2450 rpm
Engine Oil Pressure		44 psig (303 kPa) or higher (high speed) 25 psig (172 kPa) or lower (low speed)
Intake Valve Clearance		0.0079 in. (0.20 mm)
Exhaust Valve Clearance		0.0079 in. (0.20 mm)
Valve Setting Temperature		70 F (21 C)
Fuel Injection Timing		14° BTDC
Low Oil Pressure Switch		Closes 7 to 13 psi (48 to 90 kPa) or lower (shutdown)
High Coolant Temperature Switch:	Closes	215 to 225 F (102 to 107 C) or higher (shutdown)
	Opens	190 F (88 C) or lower (OK)
Engine Thermostat		180 F (82 C)
Cooling System Capacity		3 quarts, 2 ounces (3.8 liters) with overflow tank
Engine Coolant Type***		GM 6038M or equivalent low silicone antifreeze mixture, 50/50 antifreeze/water mixture, not to exceed 60/40.
Radiator Cap Pressure		10 psig (69 kPa)

Thermo King synthetic oil is compatible with petroleum lubricants so there is no danger if accidental mixing occurs or if an emergency requires addition of petroleum oil. Mixing is not recommended, however, since it will dilute the superior performance properties of the synthetic oil.

****Multi-viscosity weight oil with the recommended API classification may be used based on the ambient temperature and straight weight viscosity recommendations above. The above recommendations are written for mineral oil based lubricants.***

*****Do not use high silicone automobile antifreeze.***

EVAPORATOR - ELECTRICAL

Voltage	14 volts DC (nominal)
Fan Motors	Horsepower: 1/16 HP RPM: 1850 Full Load Current: 14.5 amps

BELT TENSION*

	Tension No. on TK Gauge 204-427
Engine (Clutch)/Alternator/Motor/Jackshaft	53
Water Pump	40
Compressor/Jackshaft (Electric Motor)/Condenser Fan	50

NOTE: These are original factory settings. Because it is difficult to use the TK Gauge 204-427 in the field, adjust each belt to allow 1/2 inch (13 mm) deflection at the center of the longest span of A and 3V belts only.

MICROPROCESSOR CONTROLLER TG-V FACTORY SETTINGS

Temperature Display	Fahrenheit
Save Elapsed Time	Yes. The defrost interval timer will save the time which has elapsed since the last defrost cycle, even if the unit is shut off.
Defrost Terminate Time	45 minutes
Defrost Time Interval	4 hours
High Speed Delay	No
High Speed Heat Lockout	Yes, at setpoint below 15 F (-9.5 C)

ELECTRICAL CONTROL SYSTEM

Voltage	12.5 volts DC (nominal)
Circuit Breaker, Control Circuit	20 amp remote reset
Circuit Breaker, Glow Plugs and Starter	50 amp remote reset
Circuit Breaker, Evaporator Fan	30 amp remote reset
Control Circuit Fuse	60 amps
Battery Charging Alternator	12 volt, 37 amp, brush type
Voltage Regulator Setting	14.0 to 14.2 volts @ 77 F (25 C)

ELECTRIC STANDBY

Electric Motor	5 hp, 230/460 V, 60 Hz
RPM	1750 rpm
Full Load Amps	14.4/7.2
Locked Rotor Amps	58

STANDBY POWER REQUIREMENTS

Voltage/Phase Frequency	Horsepower	Power Supply Circuit Breaker	Power Cord Size (AWG) Up to		
			25’	50’	75’
230/1/60	5	40	12	10	8
230/3/60	5	30	12	12	10
460/3/60	5	15	14	14	14

R-404A REFRIGERATION SYSTEM

Compressor Model		ICE TK 208R
Refrigerant Charge		5.8 pounds (2.6 kg) R-404A
Compressor Oil Charge*		12 ounces (354 ml)
Compressor Oil Type		Ester Base oil (TK 203-413)
Suction Pressure Regulator Setting		25 psig (172 kPa)
Heat/Defrost Method:	Engine Operation	Hot gas
	Electric Operation	Hot gas and optional electric heater strips
Defrost Termination Switch:	Opens	52 F (11 C)
	Closes	42 F (6 C)
High Pressure Cutout Switch:	Opens	440 to 475 psig (3034 to 3275 kPa) or higher (shutdown) Automatic reset at 337 to 413 psi (2324 to 2848 kPa)
Low Pressure Cutout Switch:	Opens	5 to 11 in. vacuum (-17 to -37.2 kPa)
	Closes	4 to 7 psig (28 to 48 kPa)
Defrost Time Interval		Programmable 2 to 16 hours in 2 hour increments

When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the replacement compressor on the unit.

AIR SWITCH

Air Switch Setting	0.50 ± 0.05 in. (12.7 ± 1.3 mm) H_2O

THERMOSTAT

Type	Solid state Thermoguard V thermostat
Range	-20 to 80 F (-27 to 27 C)
Heat Lockout: Continuous Operation	High speed heat locked out below 15 ± 3 F (-9.4 ± 1.7 C)
CYCLE-SENTRY Operation (Operational Equipment	All heat locked out below 15 ± 3 F(-9.4 ± 1.7 C)
Electric Standby Operation (Optional Equipment)	All heat locked out below 15 ± 3 F(-9.4 ± 1.7 C)

ELECTRICAL CONTROL SYSTEM

Voltage	12.5 volts dc
Fuse Link Rating	50 to 55 amps
Main Circuit Breaker	50 amp auto reset
Control Circuit Breaker	20 amp auto reset
Fan Motor Circuit Breaker	30 amp
Battery Charging	12 volt 37 amp alternator
Voltage Regulator Setting	14.0 to 14.2 volts @ 77 F (25 C)
Unloading Timer	40 ± 5 seconds

ELECTRICAL COMPONENTS

NOTE: Disconnect components from unit circuit to check resistance.

	Current Draw (Amps)	Resistance—at 12.5 Vdc (Ohms)
Glow Plug		8.31.5
Fuel Solenoid: Pull In		30 to 40.41 to.31
Hold In		0.9712.8
Throttle Solenoid		3.33.8
Liquid Line Solenoid		0.917.0
Hot Gas Solenoid		0.917.0
Starter Motor	90 to 105 (cranking)	
Evaporator Fan Motor (Each)		7-12

Electrical Standby (Model 50 Unit Only)

Voltage/Phase/Frequency	Horsepower	Kilowatts	rpm	Full Load (amps)	Overload Relay Setting (amps)
230/1/60*	5	3.7	1750	14.5	18
230/3/60	6	4.5	1760	16.4	10
380/3/60	5	3.7	1630	8.0	10
460/3/60	5	3.7	1630	8.2	10
220/3/50 EEC	6	4.5	1760	16.4	18
230/3/60 EEC	5	3.7	1630	13.8	18
380/3/50 EEC	5	3.7	1630	8.0	10

***Uses the three-phase motor and a phase converter.**

Maintenance Inspection Schedule

Pre trip	750 Hours	1,000 Hours	3,000 Hours Yearly	Maintenance interval may be extended to 2000 hours when equipped with bypass oil filter. Inspect/Service These Items
				Engine
•				Check fuel supply.
•	•			Check engine oil level.
•	•			Inspect belts for condition and proper tension.
•	•			Check engine oil pressure hot, on high speed. Minimum 40 psig (276 kPa or 2.8 bar).
•	•		•	Listen for unusual noises, vibrations, etc.
	•			Change oil in oil bath air cleaner cup, clean and service crankcase breather and check air cleaner hose for damage.
	•			Change fuel filter/water separator.
			•	Drain water from fuel tank and check vent.
	•			Inspect/clean fuel prefilter and electric fuel pump filter.
			•	Change engine coolant every two years. Maintain year around antifreeze protection at -30 F (-34 C).
			•	Check and adjust engine speeds (high and low speed).
			•	Check condition of engine mounts.
				ENGINE OIL CHANGE INTERVALS: ENGINE ***NOTE: Change engine oil and filters (hot).***
	•			EMI Oil change interval with CG-4 oils.
		•		EMI Oil change interval with CG-4 oils, with new TK 11-9321 by-pass filter.
	•			Synthetic Oil change interval, without by-pass filter.
		•		Synthetic Oil change interval with CG-4 oils, with new TK 11-9321 by-pass filter.

NOTE: With belt removed, spin bearings by hand. Listen for noise (bearings roll freely).

Pre trip	750 Hours	1,000 Hours	3,000 Hours Yearly	Maintenance interval may be extended to 2000 hours when equipped with bypass oil filter. Inspect/Service These Items
				Electrical
•	•			Check alternator voltage screen.
	•			Check defrost initiation and termination.*
	•			Check thermostat cycle sequence.*
	•			Inspect battery terminals and electrolyte level.
	•			Check operation of protection shutdown circuits.*
	•			Inspect electrical contacts for pitting or corrosion.
	•			Inspect wire harness for damaged wires or connections.
			•	Check calibration of return and discharge air sensor, and optional air sensors, in 32 F (0 C) ice water.
			•	Check air switch setting.
			•	Inspect electric motor bearings.*
			•	Inspect DC (battery charging) alternator bearings* and brushes.
			•	Check discharge and suction pressures.
			•	Check compressor efficiency.
			—	Replace dehydrator and compressor oil filter every two years.
				Refrigeration
•	•			Check refrigerant level.
•	•			Check compressor oil level.
	•		•	Check suction pressure regulator/throttling valve operation on defrost or heat.
				Structural
•	•			Visually inspect unit for fluid leaks (coolant, oil, refrigerant).
•	•			Visually inspect unit for damaged, loose or broken parts (includes air ducts and bulk-heads, if so equipped).
	•		•	Inspect clutch for shoe and anchor bushing wear with a mirror.*
			•	Inspect idler bearings for leakage and bearing wear.*
			•	Clean entire unit including condenser and evaporator coils and defrost drains.
			•	Check all unit, fuel tank, engine and electric motor mounting bolts, brackets, lines, hoses, etc.

NOTE: With belt removed, spin bearings by hand. Listen for noise (bearings roll freely).

Unit Description

The CD-II MAX is a one-piece, diesel powered, temperature control unit designed especially for straight trucks. The unit mounts on the front of a truck. The evaporator extends into the box. There are two basic models:

- Model 30: Cool, hot gas heat, and defrost on engine operation; hot water heat (optional)
- Model 50: Cool, hot gas heat, and defrost on engine operation and electric standby operation (optional electric evaporator heaters are available for extra heating capacity on electric standby); hot water heat (optional).

During engine operation, power is provided by the TK 2.49 two-cylinder, water-cooled, diesel engine rated at 7.4 continuous horsepower (6.1 KW) at 2600 rpm. A centrifugal clutch (mounted on the engine) and a belt drive system transfer energy to the compressor, the condenser fan, and the alternator. The centrifugal clutch engages when the engine reaches 900 ± 100 rpm. The clutch isolates the engine from the belt drive system during electric operation. Electric standby power (Model 50) is provided by an electric motor.

THERMOGUARD V Thermostat (TG-V)

Accurate temperature control of the cargo area is provided by a TG-V, which is a programmable microprocessor controller. Normally Heat Lockout is enabled on the TG-V. Heat Lockout does not allow the TG-V to demand High Speed Heat at setpoints below 15 F (-9.4 C). Special units may not have Heat Lockout enabled.

CYCLE-SENTRY Start-Stop Controls (Optional)

A CYCLE-SENTRY Start-Stop fuel saving system is available to provide optimum operating economy.

WARNING: With the CYCLE-SENTRY switch in the AUTO START-STOP position and the ON/OFF switch in the ON position, the unit may start at any time without prior warning.

NOTE: A buzzer sounds when the unit is automatically preheating.

The CYCLE-SENTRY system automatically starts the unit on thermostat demand and shuts down the unit when the box temperature reaches the thermostat setpoint. The CYCLE-SENTRY system automatically maintains engine temperature in cold ambients by restarting the unit if the engine block temperature drops to 32 F (0 C). When the unit starts because of low engine blow temperature, it will run in the operating mode called for by the unit thermostat until the battery is fully charged and the engine block temperature reaches 90 F (32.2 C).

Features of the CYCLE-SENTRY system are:

- Offers either CYCLE-SENTRY (CYCLE) or Continuous Run (CONTINUOUS) operation.
- Thermostat controlled all season temperature control.
- Maintains minimum engine temperature in low ambient conditions.
- Variable glow plug preheat time.
- Preheat indicator buzzer.

Cab Control Box (Optional)

An optional cab control box is available. It allows the driver to control and monitor some of the unit functions from inside the cab. The auto start system is included with this option. The auto start system controls the preheat, run, and start relays to automatically start the unit when the unit is turned on. Refer to the Operating Instructions for a detailed description.

Remote Control Box (Optional)

An optional remote control box is available. It is normally mounted on the truck below the unit and allows the driver to control some unit functions without having to reach the unit.

OPERATING MODES

High Speed Heat is locked out at setpoints below 15 F (-9.4 C).

The CD-II MAX does not have a three-way valve. It has a liquid line solenoid (LLS) and a hot gas solenoid (HGS) instead. The LLS is normally open. The HGS is normally closed. The LLS and the HGS are both energized by the 26 circuit, which is controlled by the heat relay (1K).

Cool

When the thermostat is calling for cool, the heat relay is not energized. Therefore, the 26 circuit is not energized, the LLS is open and the HGS is closed. The discharge gas from the compressor must flow through the cool circuit (condenser, receiver, drier, heat exchanger, expansion valve, distributor, evaporator, heat exchanger, accumulator, and suction pressure regulator) to return to the compressor.

Heat

When the thermostat is calling for heat, the heat relay is energized. Therefore, the 26 circuit is energized, the LLS is closed and the HGS is open. The discharge gas from the compressor must flow through the heat circuit (pan heater, distributor, evaporator, heat exchanger, accumulator, and suction pressure regulator) to return to the compressor.

Units may be equipped with the hot water heat option. The evaporator water solenoid is energized by the 26 circuit. This routes hot engine coolant through a special evaporator circuit.

Model 50 units may be equipped with optional electric evaporator heaters. During electric operation, the evaporator heaters are energized when the heater contactor is energized by the 26 circuit.

Defrost

Defrost can be initiated with the manual defrost switch, by the air switch, or by the defrost timer any time the evaporator coil temperature is below 42 F (5.6 C). If the unit is in null (CYCLE-SENTRY or electric operation), manually initiating defrost will cause the unit to start and operate in defrost. When defrost is initiated, the defrost relay is energized. This energizes the 26 circuit, the Defrost light, and the low speed defrost relay, and de-energizes the fan relay. Energizing the low speed defrost relay de-energizes the throttle solenoid. De-energizing the fan relay de-energizes the evaporator fan motors.

The unit remains on defrost until the evaporator coil temperature rises to 52 F (11.1 C) causing the defrost termination switch to open. When the defrost termination switch opens, the defrost relay is de-energized and the thermostat determines the unit's mode of operation.

ENGINE OPERATION

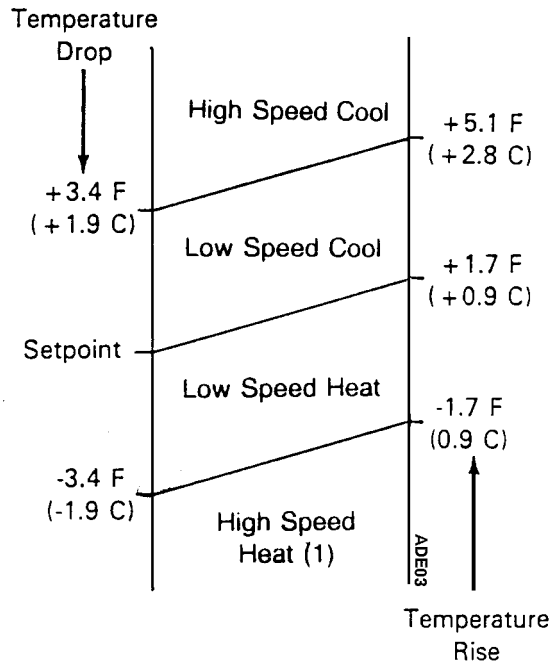
Continuous Run Operation

At setpoints above 15 F (-9.4 C), the unit operates in the following modes:

- **High Speed Cool**
- **Low Speed Cool**
- **Low Speed Heat**
- **High Speed Heat**
- **Defrost**

At setpoints below 15 F (-9.4 C), the unit operates in the following modes:

- **High Speed Cool**
- **Low Speed Cool**
- **Low Speed Heat**
- **Defrost**



(1) If High Speed Heat Lockout is enabled, High Speed Heat is replaced by Low Speed Heat at setpoints below 15 F (-9.4 C)

TG-V Control Algorithm
Continuous Run

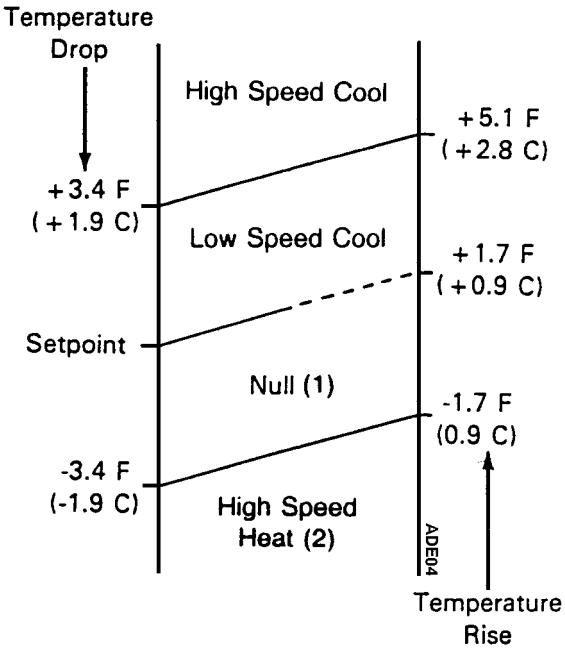
CYCLE-SENTRY Operation (Optional)

At setpoints above 15 F (-9.4 C), the unit operates in the following modes:

- **High Speed Cool**
- **Low Speed Cool**
- **Low Speed Heat—**Null if block temperature switch is satisfied.
- **High Speed Heat**
- **Defrost**

At setpoints below 15 F (-9.4 C), the unit operates in the following modes:

- **High Speed Cool**
- **Low Speed Cool**
- **Low Speed Heat—**Null if block temperature switch is satisfied.
- **Defrost**



(1) Low Speed Heat if CYCLE-SENTRY system determines unit should be running.
(2) If High Speed Heat Lockout is enabled, High Speed Heat is replaced by Null at setpoints below 15 F (-9.4 C).

TG-V Control Algorithm
CYCLE-SENTRY

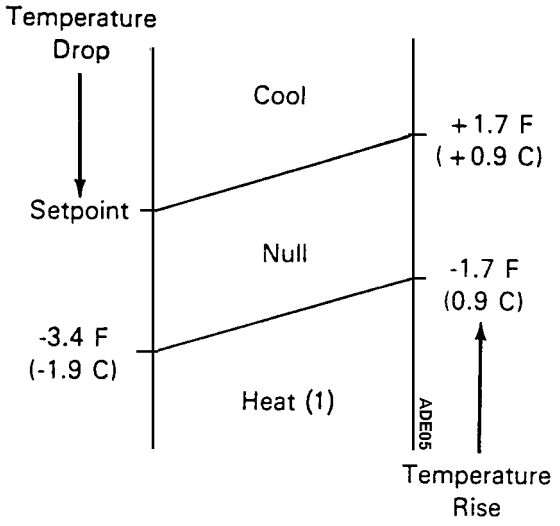
Electric Operation (Model 50)

At setpoints above 15 F (-9.4 C), the unit operates in the following modes:

- **Cool**
- **Null**
- **Heat**
- **Defrost**

At setpoints below 15 F (-9.4 C), the unit operates in the following modes:

- **Cool**
- **Null**
- **Defrost**



(1) If High Speed Heat Lockout is enabled, Heat is replaced by Null at setpoints below 15 F (-9.4 C)

TG-V Control Algorithm
Electric Operation

SERIAL NUMBER LOCATIONS

Unit: Nameplate on the curbside of the unit frame.

Engine: Nameplate on the rocker arm cover.

Compressor: Nameplate on the compressor body.

Standby Motor: Nameplate on the motor.

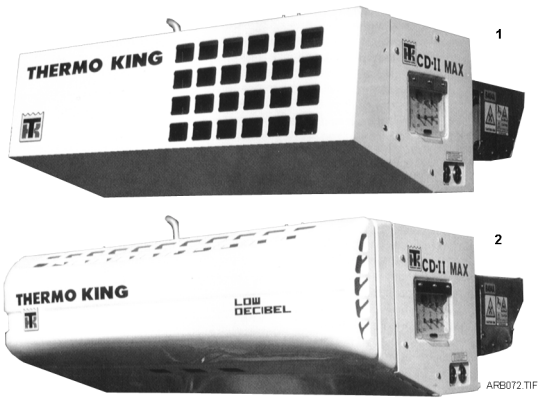
DESIGN FEATURES	UNIT MODEL CD-II MAX 30 (919060)
TK 2.49 Diesel Engine	•
TK 208R (ICE) Compressor	•
Tapered Roller Bearing Jackshaft	•
Oil Bath Air Cleaner	•
Dry Air Cleaner	Opt
Inlet and Outlet Fuel Lines	•
Electric Fuel Pump	•
Fuel Prefilter	•
Spin-On Full Flow Oil Filter	•
Spin-On Bypass Oil Filter	Opt
Spin-On Fuel Filter	•
EPDM Coolant Hoses	•
Top Screen	Opt
Coolant Expansion Tank	•
Hourmeter (Measures Engine Run Time)	•
Thermoguard V Thermostat (TG-V)	•
Defrost Timer (Built into TG-V)	•
37 Amp Alternator	•
Stainless Steel Exterior Condenser Hardware	•
Stainless Steel Evaporator Hardware	•
CYCLE-SENTRY	Opt
Cab Control Box	Opt
Remote Control Box	Opt
R-404A	•
Hot Water Heat, Engine Coolant	Opt
Silicone Coolant Hoses	Opt

PROTECTION DEVICES	UNIT MODEL CD-II MAX 30 (919060)
ENGINE LOW OIL PRESSURE Switch	•
ENGINE HIGH WATER TEMPERATURE Switch	•
REFRIGERANT HIGH PRESSURE CUTOUT Switch	•
Fuse Link	•
Circuit Breaker in Main Power Circuit	•
Circuit Breaker in Control Circuit	•
Control Breaker in Fan Motor Circuit	•

DESIGN FEATURES	UNIT MODEL CD-II MAX 50 230/1/60 (919065)	UNIT MODEL CD-II MAX 50 230/3/60 (919066)	UNIT MODEL CD-II MAX 50 380-460/3/50-60 (919067)
TK 2.49 Diesel Engine	•	•	•
TK 208R (ICE) Compressor	•	•	•
Electric Standby Motor 230/3/60	—	•	—
Electric Standby Motor 380-460/3/50-60	—	—	•
Electric Standby Motor 230/1/60	•	Opt	—
Electric Evaporator Heaters	Opt	Opt	Opt
Oil Bath Air Cleaner	•	•	•
Dry Air Cleaner	Opt	Opt	Opt
Electric Fuel Pump	•	•	•
Fuel Prefilter	•	•	•
Spin-On Full Flow Oil Filter	•	•	•
Spin-On Bypass Oil Filter	•	Opt	Opt
Spin-On Fuel Filter	•	•	•
EPDM Coolant Hoses	•	•	•
Top Screen	Opt	Opt	Opt
Coolant Expansion Tank	•	•	•
Hourmeter, Engine Hours	•	•	•
Hourmeter, Electric Standby Hours	Opt	Opt	Opt
Thermoguard V Thermostat (TG-V)	•	•	•
Defrost Timer (Built into TG-V)	•	•	•
37 Amp Alternator	•	•	•
Stainless Steel Exterior Condenser Hardware	•	•	•
Stainless Steel Evaporator Hardware	•	•	•
Inlet and Outlet Fuel Lines	•	•	•
CYCLE-SENTRY	Opt	Opt	Opt
Cab Control Box	Opt	Opt	Opt
Remote Control Box	Opt	Opt	Opt
R-404A		•	•
Hot Water Heat, Engine Coolant	Opt	Opt	Opt
Silicone Coolant Hoses	Opt	Opt	Opt

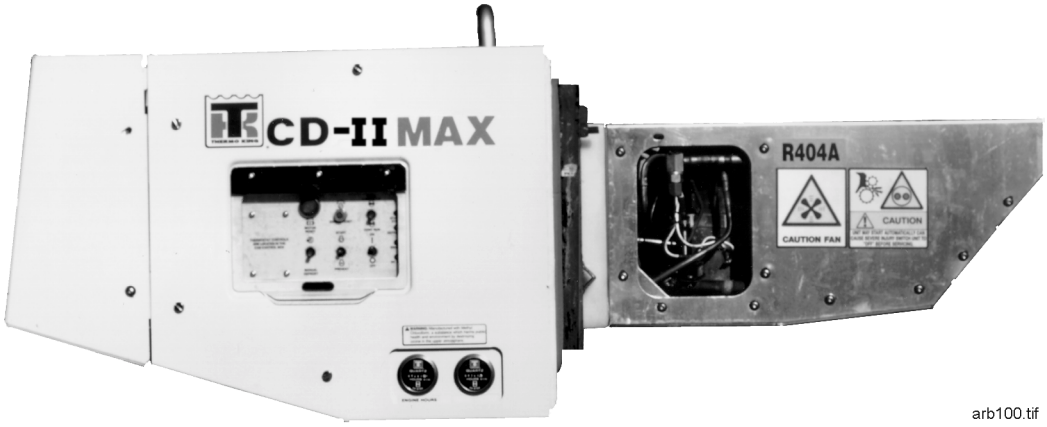
PROTECTION DEVICES	UNIT MODEL CD-II MAX 50 230/1/60 (919065)	UNIT MODEL CD-II MAX 50 230/3/60 (919066)	UNIT MODEL CD-II MAX 50 380-460/3/50-60 (919067)
ENGINE LOW OIL PRESSURE Switch	•	•	•
ENGINE HIGH WATER TEMPERATURE Switch	•	•	•
REFRIGERANT HIGH PRESSURE CUTOUT Switch	•	•	•
Fuse Link	•	•	•
Circuit Breaker in Main Power Circuit	•	•	•
Circuit Breaker in Control Circuit	•	•	•
Control Breaker in Fan Motor Circuit	•	•	•
Electric Motor Overload Relay	•	•	•
High Temperature Switch (with Electric Heater Option)	Opt	Opt	Opt

UNIT PHOTOGRAPHS



1.	Standard CD-II MAX
2.	CD-II MAX with Low Noise Option

Front View



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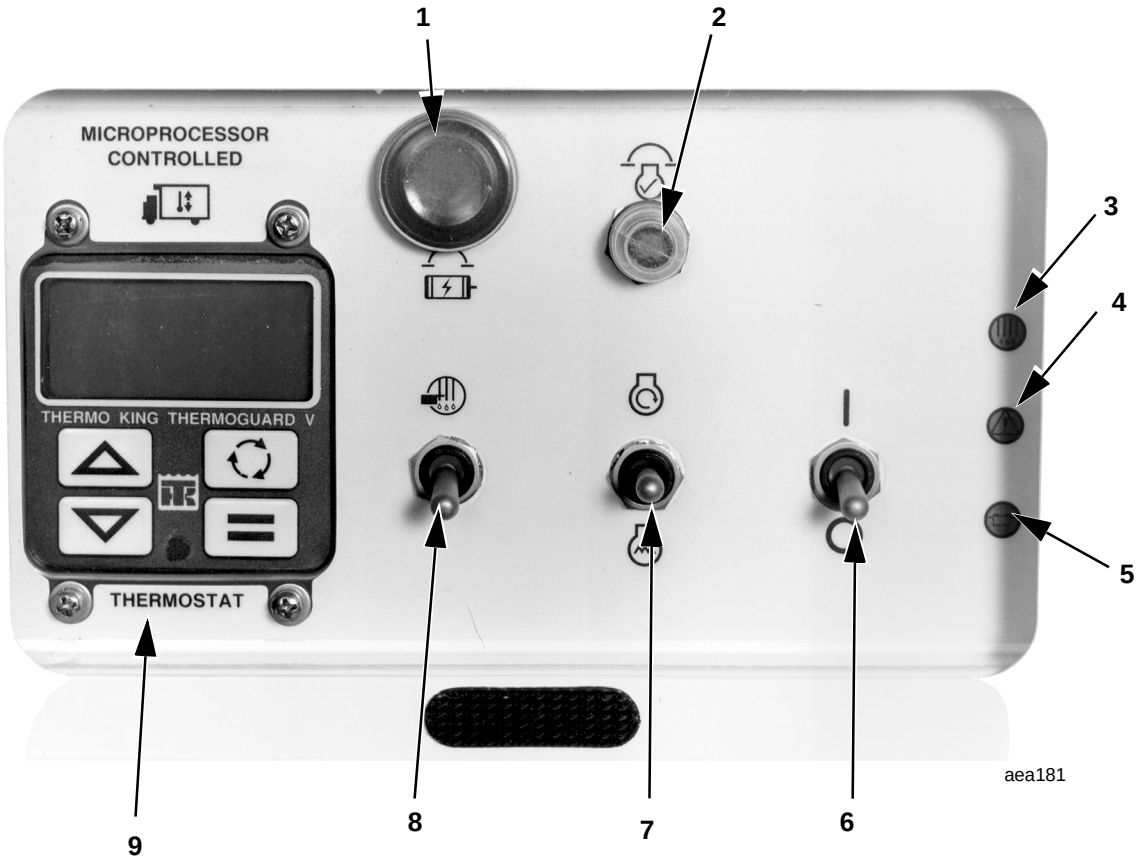
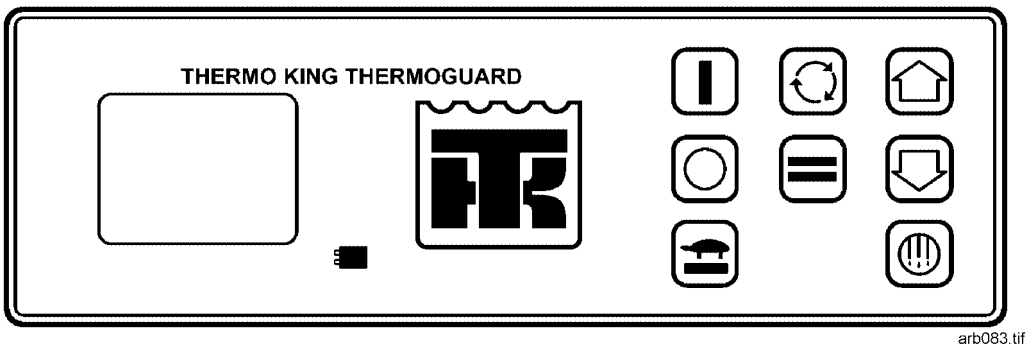
Roadside View

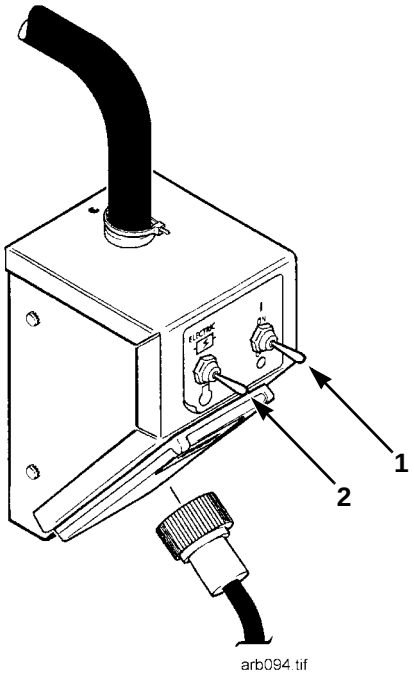


1.	Motor Reset Button
2.	Engine Reset Button
3.	START/STOP Light
4.	Engine Light
5.	DC Alternator Light
6.	ON/OFF Switch
7.	PREHEAT/START Switch
8.	Manual Defrost Switch
9.	TG-V Thermostat

Control Panel

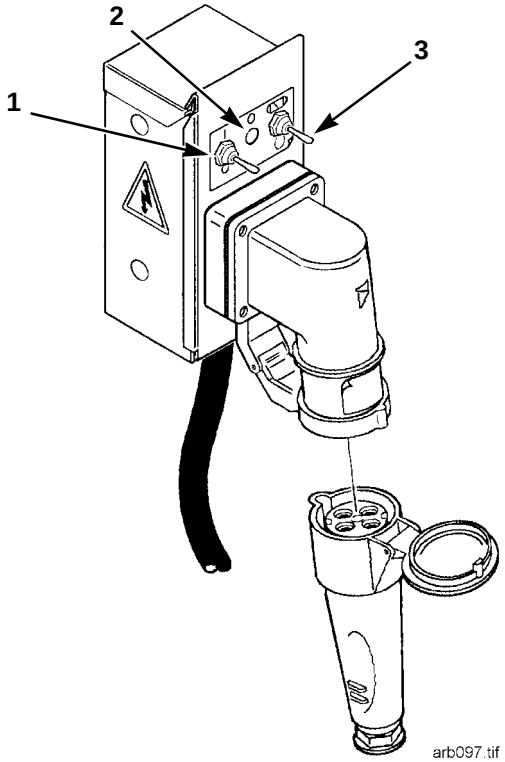


In-Cab TG-V Controller



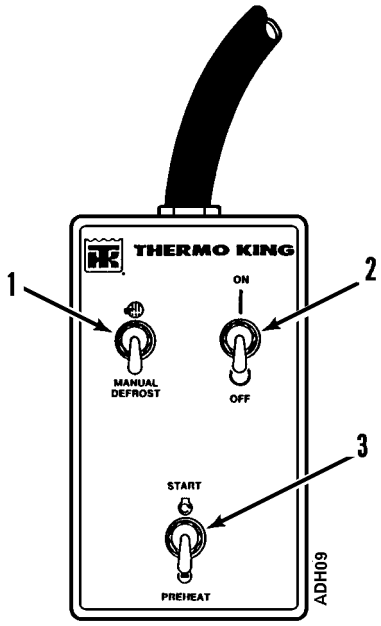
1.	ON/OFF Switch
2.	DIESEL/ELECTRIC Switch

Electric Standby Power Receptacle—Model 50 Domestic Only



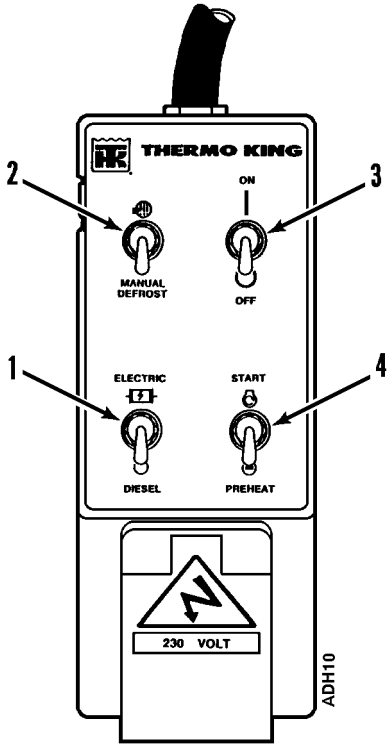
1.	DIESEL/ELECTRIC Switch
2.	Optional Electronic High Temperature Switch LED (EEC Units with Electric Evaporator Heaters Only)
3.	ON/OFF Switch

Electric Standby Power Receptacle—Model 50 EEC Only



1.	Manual Defrost Switch
2.	ON/OFF Switch
3.	PREHEAT/START Switch

Optional Remote Control Box—Model 30



1.	DIESEL/ELECTRIC Switch
2.	Manual Defrost Switch
3.	ON/OFF Switch
4.	PREHEAT/START Switch

Optional Remote Control Box—Model 50 Domestic

UNIT CONTROLS

1. ON/OFF SWITCH. This switch energizes the electrical system of the unit.

   a. ON position. The unit will operate in response to the thermostat setting and the trailer air temperature.

   b. OFF position. The fuel solenoid that controls the supply of fuel is de-energized to stop the engine. The unit will not operate.

   NOTE: Model 50 units are also equipped with an ON/OFF switch in the Electric Standby Power Receptacle. The optional Cab Control Boxes and Remote Control Boxes also contain ON/OFF switches. All of the ON/OFF switches must be in the ON position to allow the unit to operate.

2. PREHEAT/START SWITCH. When positioned in PREHEAT, the PREHEAT/START switch energizes the glow plugs to aid in starting the diesel engine. When positioned in START, the PREHEAT/START switch energizes both the glow plugs and the starting motor. Hold the switch on START until the engine starts to fire and pick up speed. DO NOT release the switch from the START position prematurely when the engine is extremely cold.

3. DIESEL/ELECTRIC SWITCH (Model 50 only). The DIESEL/ELECTRIC switch disconnects the engine controls and engine protection devices from the electrical system when placed in the ELECTRIC position. The switch is mounted in the remote control and power connector box.

4. MANUAL DEFROST SWITCH. The unit can be placed in defrost by pressing the MANUAL DEFROST switch. The evaporator coil temperature must be below 42 F (5.6 C) before the unit will defrost.

5. THERMOSTAT—TG-V MICROPROCESSOR CONTROLLER. The TG-V is a solid-state, programmable microprocessor that uses external relays to control unit operation and maintains the cargo area temperature at thermostat setpoint.

   Set the thermostat at the required temperature. Programming the thermostat to a lower temperature will not make the unit cool faster.

   Features of the TG-V include: thermometer, thermostat, defrost timer, fuel saver and alarm.

   NOTE: TG-V thermostats have low voltage and open circuit protection. If there is no power from the battery to the thermostat or if the battery leads to the thermostat are reversed, the thermostat switches the unit to Low Speed Cool. If the sensor circuit is open, the unit switches to Low Speed Cool. If the battery voltage drops below 6 Vdc, the unit will shift to Low Speed Cool.

6. ELECTRONIC HIGH TEMPERATURE SWITCH LED (EEC units with Optional Electric Evaporator Heaters only—Model 50 only). This LED lights up to indicate that the electronic high temperature switch is open.

7. DEFROST AIR SWITCH. The DEFROST AIR SWITCH senses the air pressure difference between the evaporator coil inlet and outlet. The switch automatically places the unit on defrost when the evaporator temperature is below 42 F (5.6 C) and frost builds up on the coil to a point where the air flow across the coil is restricted.

8. DEFROST TERMINATION Switch. The electronic defrost termination switch uses solid-state components to control the defrost circuit. The switch has short circuit protection and solid state reliability. The switch is mounted in the evaporator and controls the defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 42 F (5.6 C) completing the defrost circuit to ground and preparing the electrical system for the defrost cycle.

9. Timers.

   a. UNLOADING TIMER (UT)—The UNLOADING timer (UT) energizes the unloading relay (UL) for approximately 40 seconds when the engine is first started to reduce the load on the engine.

   b. CLUTCH TIMER (CLT)— The CLUTCH timer (CLT) keeps the clutch relay (CLR) from energizing for 20 seconds when the engine is first started to reduce the load on the engine. The clutch is timed to be staged in 20 seconds earlier than the evaporator fans.

10. AUTO START-STOP/CONTINUOUS RUN SWITCH (Optional). This switch selects continuous run operation or automatic start-stop operation.

    a. CONTINUOUS RUN position. The unit must be started manually with the unit ON/OFF switch and Preheat-Start switch. After start-up, the unit operates continuously until the unit ON/OFF switch is turned off or a unit reset switch protection circuit shutdown occurs due to a malfunction in the fuel, engine oil, engine coolant or unit refrigeration system.

    b. AUTO START-STOP position. All unit starting operations are performed automatically on thermostat demand. Starting functions such as throttle solenoid control, preheat, and cranking are performed automatically.

    Unit operation is controlled automatically by unit thermostats, engine block temperature thermostat, Battery Sentry and defrost controls.

    The engine starts automatically whenever the thermostat calls for cooling or heating, or when the engine block temperature drops to 30 F (0 C). The engine is automatically stopped by the CYCLE-SENTRY control module when the thermostat demand is satisfied, the battery is fully charged, and the block temperature reaches 90 F (32.2 C).

CAUTION: With the selector switch in AUTO START-STOP position and the unit ON/OFF switch in the ON position, the unit may start at any time without prior warning.

11. REMOTE CONTROL BOX (Outside) (Optional). The switches in the remote control box energize relays on the option board to control the operation of the unit. The remote ON/OFF switch and the unit ON/OFF switch must both be in the ON position for the unit to operate. Either switch will turn the unit off.

    The remote control box mounts on the truck body beneath the unit to offer easier accessibility to unit controls. This box offers the following functions:

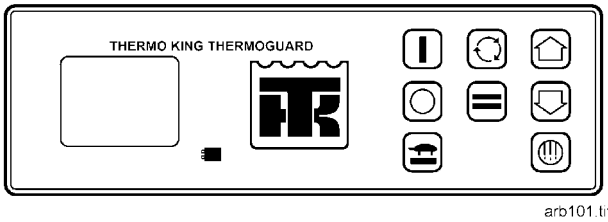
    a. PREHEAT/START SWITCH. When pressed to PREHEAT, the switch energizes the glow plugs to aid in starting. When pressed to START, it energizes both the glow plugs and the starter motor.

    b. ON/OFF SWITCH. The ON/OFF switch energizes the ON relay, activating the unit electrical system. The control panel ON/OFF switch and the remote ON/OFF switch must both be on in order for the unit to operate. Either switch can stop the unit.

    c. MANUAL DEFROST. Pressing the MANUAL DEFROST switch will initiate a defrost cycle if the evaporator coil temperature is below 42 F (5.6 C).

d. DIESEL/ELECTRIC SWITCH (Model 50 only). Switches the unit to electric motor standby power when placed in ELECTRIC position and power cord is connected to the box.

IN-CAB TG-V CONTROLLER



In-Cab TG-V Controller

The In-Cab TG-V functions similarly to the standard unit mounted TG-V. However, the In-Cab TG-V Controller also has the following features:

Features include:

Thermometer. Displays return air temperature and (optional) discharge air temperature with 0.5 degree accuracy.

Thermostat. Provides temperature control from -20 to 80 degrees Fahrenheit or -30 to 30 degrees Celsius, in 0.5 degree increments.

Defrost Control. When the evaporator coil is cold enough for frost to form, defrost is automatically initiated every 4 hours during pulldown until the return air temperature is in-range. At in-range temperatures (between approximately 7 degrees above and 7 degrees below setpoint) the controller is programmable for 1 hour or 2 to 16 hours in 2 hour increments. Defrost interval is set at the factory but can be reprogrammed by your Thermo King Dealer.

Fuel Saver. Can be programmed to delay high speed operation for optimum fuel economy.

Alarm. Can detect and display up to 6 alarm conditions including sensor, microprocessor and defrost termination failures plus engine or standby electric stoppage.

There is nothing complicated about learning to operate the controller, but you will find that a few minutes studying the contents of this manual and the In-Cab Controller Operating Manual TK 40940 will be time well spent.

This manual is published for informational purposes only and the information furnished herein should not be considered as all-inclusive or meant to cover all contingencies.

Display Symbols and Control Keys

The following is a list of the display symbols and control keys used in the In-Cab Controller. It is recommended that you become completely familiar with the meaning of each symbol and the function of each control key before operating the unit.

ON Key

I (One) is used to turn on the controller.

NOTE: The main unit ON/OFF switch must be set to ON before the In-Cab Controller can be turned on. The unit engine will automatically start. Also, the In-Cab Controller must be ON before the main unit can be started.

OFF Key

O (Zero) is used to turn off the controller and stop the engine or standby motor.

SELECT Key

(Cycling arrows) is used to select the various displays which can appear on the screen.

Display Symbols and Control Keys (continued)

UP Key

(Arrow pointing upward) When the setpoint symbol is on the screen, this key is used to increase the setpoint temperature.

DOWN Key

(Arrow pointing downward) When the setpoint symbol is on the screen, this key is used to decrease the setpoint temperature.

ENTER Key

(Equal sign) is used to enter new information into the controller.

NOTE: The ENTER key must be pressed within 6 seconds after releasing the UP or DOWN key to complete the setpoint change.

DEFROST Key

(Coil and water drops within circle) is used to start the defrost cycle of the unit.

LOW NOISE Key

(Turtle) is used to lock out high speed operation to maintain low speed (low noise) operation.

UNIT INSTRUMENTS

1. AMMETER (Optional). The ammeter indicates the battery charging and discharge amperage during engine operation. The charging amperage varies according to the needs of the battery. The ammeter also indicates the amount of current drawn by the glow plugs during preheat.
2. HOURMETER—ENGINE. The engine hourmeter records the total number of hours that the engine is in operation so proper maintenance can be scheduled.
3. HOURMETER—ELECTRIC STANDBY (Optional). The electric standby hourmeter records the total hours of unit operation on electric standby power.
4. HOURMETER—TOTAL (Optional). This hourmeter records the total number of hours the unit switch is turned on.
5. SIGNAL LIGHTS. The control panel lights indicate the following:

   RED—Engine—indicates that the reset switch is open.

   YELLOW—Alternator—indicates no alternator output.

   GREEN—Start-Stop—indicates the unit is operating in the CYCLE-SENTRY Start-Stop mode of operation.

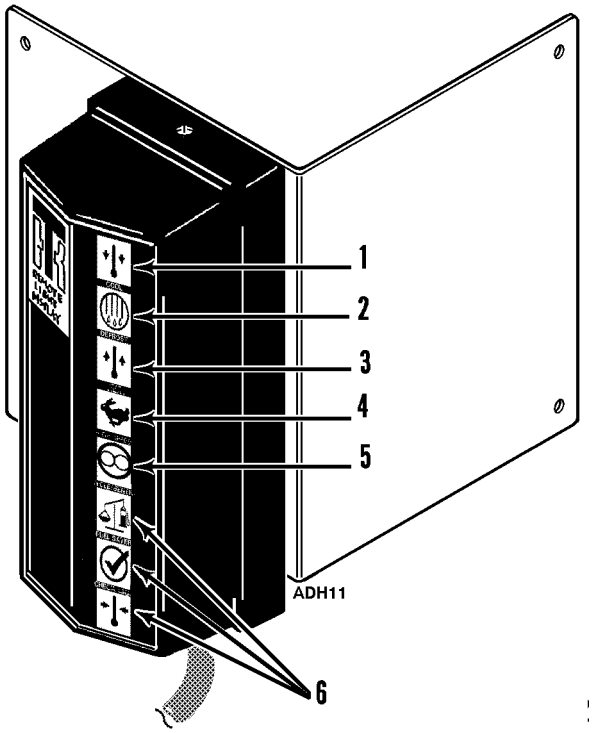
   ORANGE—Defrost—indicates the unit is operating in the defrost mode.
6. COMPOUND PRESSURE GAUGE (Optional). The compound gauge indicates the pressure in the compressor crankcase.
7. RECEIVER TANK SIGHT GLASS. The receiver tank sight glass indicates the level of refrigerant in the receiver tank for checking the refrigerant charge.
8. REMOTE LIGHT INDICATORS (Optional). Remote indicator lights in a box that can be mounted on the truck beneath the unit feature these signals:

   WHITE—system is in cooling cycle.

   BLUE—system is in defrost cycle.

   AMBER—system is in heat cycle.

   GREEN—system is in high speed heat or cool.



1.	Cool Light
2.	Defrost Light
3.	Heat Light
4.	High Speed Light
5.	CYCLE-SENTRY Light
6.	Not Used

Remote Indicator Light Box (Optional)

UNIT PROTECTION DEVICES

1. RESET SWITCH. A thermal type manual RESET switch protects the engine. The reset switch contains a heater coil that is attached to a sensor switch in the engine oil system, engine coolant system and the CYCLE-SENTRY system (optional).

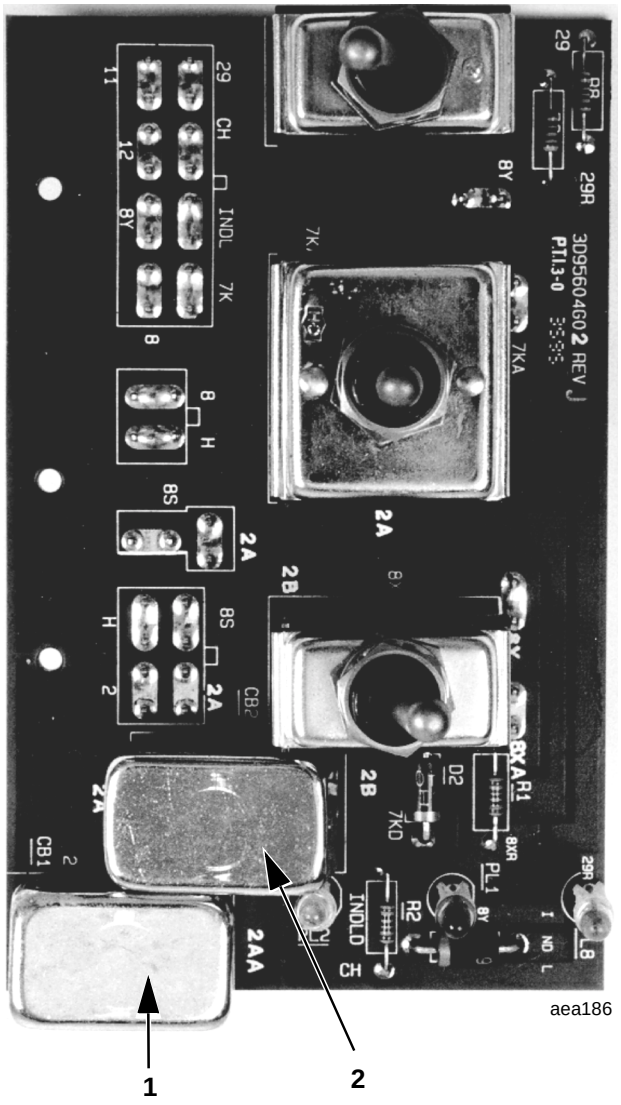
   When the engine oil pressure is too low, when the starter exceeds the cranking limit on Auto Start-Stop operation, or when the engine coolant temperature is too high, the coil in the reset switch starts to heat up. In 10 to 30 seconds, the switch will trip and shut down the unit. The switch must be manually reset.

2. CONTROL SYSTEM CIRCUIT BREAKER. Circuit breakers located behind the control panel face trip if the 12 V dc control circuits or starting circuit overloads.

   A 50 amp remote reset circuit breaker protects the unit preheat-starting circuit.

   A 20 amp remote reset circuit breaker protects the unit control circuit. Both breakers are reset by shutting off the ON/OFF switch for a minute.

   A 30 amp auto reset circuit breaker protects the evaporator fan circuit.



1.	50 Amp Circuit Breaker
2.	20 Amp Circuit Breaker

Printed Circuit Board

3. CONTROL CIRCUIT FUSE. Located between battery and unit control circuits. At about 60 amps, the fuse will blow and cut battery power to the unit.

4. HIGH PRESSURE CUTOUT. The high pressure cutout (HPCO) is a pressure sensitive switch located in the compressor head. If the discharge pressure rises above 470 psig (3241 kPa) on R-404A units, the HPCO switch opens the circuit to the throttle solenoid stopping the engine. Within 20 to 40 seconds, the reset switch will trip because of low oil pressure in the engine.

5. HIGH PRESSURE RELIEF VALVE. The high pressure relief valve is designed to relieve excess pressure within the refrigeration system. The valve is a spring-loaded piston that lifts off its seat when refrigerant pressure exceeds 525 ± 50 psig (3620 ± 345 kPa). The valve will reset when the pressure drops to 400 psig (2758 kPa). The valve could possibly leak refrigerant after it has relieved excess pressure. Tapping the valve lightly may help the valve reseat and SEAL PROPERLY. The valve is non-repairable and requires no adjustment. If the valve fails to reseat properly, remove the refrigerant charge and replace the valve.

   The high pressure relief valve is located on a high pressure line near the condenser. Its location is such that when the pressure is expelled from the valve, it would be directed away from anyone servicing the unit.

6. OVERLOAD RELAY—Manual Reset (Model 50). An overload relay protects the standby electric motor. The overload relay opens the circuit from the line starter to the electric motor if the motor overloads (e.g., low line voltage or improper power supply) while the unit is on electric standby operation.

7. EVAPORATOR HIGH TEMPERATURE PROTECTION SWITCH (Model 50 with optional Electric Evaporator Heaters only). A HIGH TEMPERATURE PROTECTIVE switch is located above the evaporator coil to interrupt the heat cycle if the temperature above the coil exceeds 150 F (66 C) during electric standby operation.
8. PREHEAT INDICATOR BUZZER. The preheat indicator buzzer is energized whenever the GLOW PLUGS are energized.
9. ELECTRONIC HIGH TEMPERATURE SWITCH (EEC Model 50 with Optional Electric Evaporator Heaters only). The ELECTRONIC HIGH TEMPERATURE switch is located in the electric standby power receptacle. It is connected to a temperature sensor located in the evaporator. If the evaporator temperature rises above 130 F (54 C), the switch opens to de-energize the heater contactor and the electric evaporator heaters. The switch closes when the temperature falls below 130 F (54 C) and the unit is turned off for one second or more.

UNIT OPERATION

Pre-trip Inspection

The following Pre-trip Inspection should be completed before loading the truck. While the Pre-trip Inspection is not a substitute for regularly scheduled maintenance inspections, it is an important part of the preventive maintenance program designed to head off operating problems and breakdowns before they happen.

1. FUEL. The diesel fuel supply must be sufficient to guarantee engine operation to the next check point.
2. ENGINE OIL. The engine oil level should be at the FULL mark with the dipstick. Never overfill.
3. COOLANT. The engine coolant must be above the ADD mark and have antifreeze protection to -30 F (-34 C). Check and add coolant in the expansion tank.

CAUTION: Do not remove radiator cap while coolant is hot.

4. BATTERY. The terminals must be clean. Electrolyte should be at FULL mark.
5. BELTS. The belts must be in good condition and adjusted to proper tension.
6. ELECTRICAL. The electrical connections should be securely fastened. The wires and terminals should be free of corrosion, cracks or moisture.
7. STRUCTURAL. Visually inspect the unit for leaks, loose or broken parts and other damage. The condenser and evaporator coils should be clean and free of debris. Check the defrost drain hoses and fittings to be sure they are open. The damper in the evaporator outlet must move freely with no sticking or binding. Make sure all the doors are latched securely.

Starting Unit on Diesel Operation

1. Switch the DIESEL/ELECTRIC switch to the DIESEL position (Model 50 unit).
2. Switch the unit ON/OFF switch to ON.

   NOTE: If the unit has a remote control box, the control panel and remote box switches must both be ON.

3. Hold the Preheat-Start switch in the PREHEAT position for the required time. The ammeter should show glow plug discharge (optional).

Ambient Temperature	Preheat Time
Above 60 F (16 C)	0 minutes
32 to 60 F (0 to 16 C)	1/2 minute
0 to 32 F (-18 to 0 C)	1 minute
Below 0 F (-18 C)	2 minutes

Starting Unit on Diesel Operation (continued)

1. Press PREHEAT-START switch to START position to crank engine. Release when the engine starts. DO NOT release the switch prematurely when the engine is extremely cold. In cold weather, it is best to repeat preheat if the engine does not start within 15 seconds of cranking time.
2. Repeat steps 3 and 4 if the engine fails to start.

CAUTION: Never use starting fluid.

Starting CYCLE-SENTRY Start-Stop Equipped Units on Diesel Operation

Selection of Operating Modes on CYCLE-SENTRY Equipped Units

The Thermo King CYCLE-SENTRY Start-Stop system (optional) is designed to save refrigeration fuel costs. The savings vary with the commodity, ambient temperatures and box insulation. However, not all temperature controlled products can be properly transported without continuous air circulation.

Since highly sensitive products will normally require continuous air circulation, CYCLE-SENTRY units come equipped with a selector switch for AUTO START-STOP or CONTINUOUS RUN operation. Your selection of operation mode for the proper protection of a particular commodity should use the following guidelines.

Examples of Products Normally Acceptable for CYCLE-SENTRY Operation

- Frozen foods (in adequately insulated trucks)
- Boxed or processed meats
- Poultry
- Fish
- Dairy products
- Candy
- Chemicals
- Film
- All non-edible products

Examples of Products Normally Requiring Continuous Run Operation of Air Flow

- Fresh fruits and vegetables, especially asparagus, bananas, broccoli, carrots, citrus, green peas, lettuce, peaches, spinach, strawberries, sweet corn, etc.
- Non-processed meat products (unless pre-cooled to recommended temperature)
- Fresh flowers and foliage

The above listings are not all inclusive. Consult your grower, shipper or USDA if you have any questions about the operating mode selection on your type of load.

Continuous Run Operation

With the selector switch in the CONTINUOUS-RUN position, the unit will operate in its regular cooling and heating modes. Refer to Starting Instructions for Standard Units.

Auto Start-Stop Operation

With the selector switch in the AUTO START-STOP position, the CYCLE-SENTRY system starts the unit on thermostat demand and shuts down the unit when the box temperature reaches the thermostat setpoint.

On CYCLE-SENTRY equipped units, the unit start-ups may also be initiated by defrost cycle initiation or engine block temperature switch demand.

If defrost is initiated manually, the unit will start and run on high speed. When the defrost cycle is complete, the unit will run in whichever operating mode the thermostat is calling for until the box temperature reaches setpoint.

In cold ambients, the CYCLE-SENTRY system automatically maintains engine temperature by restarting the unit if the engine block temperature drops to 30 F (0 C). When the unit starts up because of low engine block temperature, the unit will run in whichever operating mode the unit thermostat is calling for until the engine block temperature rises to 90 F (32.2 C).

CAUTION: With the selector switch in AUTO START-STOP position and the unit ON/OFF switch in the ON position, the unit may start at any time without proper warning.

NOTE: Initial start-up of cold soaked units in cold weather. Truck units equipped with CYCLE-SENTRY should be manually started if the units have been non-operative (turned OFF), resulting in cold soaked engine temperatures below 30 F (0 C). Place the selector switch in the CONTINUOUS RUN position and refer to Starting Instructions for CONTINUOUS RUN Operation for manual starting instructions. After this initial cold start, the selector switch can be switched to AUTO START-STOP operation. CYCLE-SENTRY sensors will then automatically maintain temperature and provide reliable unit restarts on demand.

Fully charged batteries in good condition are essential for reliable unit operation. This is especially true on CYCLE-SENTRY equipped units in cold weather.

Starting Procedure

1. Set the thermostat at the desired temperature. DO NOT set the thermostat lower than required (lowering the thermostat setting does not make the unit cool faster).
2. Place the AUTO START-STOP/CONTINUOUS RUN selector switch in the AUTO START-STOP position.
3. Place the unit On-Off switch in the ON position. The green indicator light will come on. (This green light must be on at all times while the unit is on Auto Start-Stop operation).
4. If the thermostat calls for cooling or heating, the cool or heat light (optional) will be on and the engine will preheat if necessary, then begin cranking. The glow plugs and the preheat buzzer are energized during the cranking period. If the engine rpm does not exceed 50 rpm during the first 4 seconds of cranking, or if the engine does not start after 25 seconds of cranking, the cranking cycle terminates.

   NOTE: If the engine fails to start, the unit reset switch will open, interrupting current to the control system approximately 30 seconds after the cranking cycle terminates.
5. If the engine fails to start, place the unit switch in the OFF position, determine and correct the cause for not starting, then push in the reset button and repeat the starting procedure.

Starting Units on Electric Standby Power (Model 50 Unit)

1. With the ON/OFF switch in the OFF position and the high voltage power supply off, connect the power cable to the power supply. Make sure the power supply is the proper voltage, amperage and phase.
2. Set the thermostat at the desired temperature. Do not set the thermostat lower than required (lowering the thermostat setting does not make the unit cool faster).
3. Snap the DIESEL/ELECTRIC switch to the ELECTRIC position.

CAUTION: Do not start the electric motor until the diesel engine has come to a complete stop, disengaging the clutch.

4. Turn the high voltage power supply ON and momentarily snap the ON/OFF switch to the ON position. Check for correct fan rotation by placing a small piece of cloth or paper in front of the condenser grille. Proper rotation will hold the cloth or paper to the grille, incorrect rotation will blow it away from the unit.

5. If the fan rotation is correct, leave the unit ON. If the fan rotation is incorrect, turn off the power to the cable and reverse the position of any two power leads on the power cable plug. DO NOT disturb the green ground wire. (Refer this procedure to a qualified electrical repairman.)

NOTE: If the unit fails to run, the thermostat setting may not demand operation. Check the unit thermometer and compare the box temperature with the thermostat setting. The thermostat setting must be more than 5.1 F (2.8 C) above or 3.5 F (2 C) below the box temperature to demand unit operation. If the thermostat setting is well above or below the box temperature, check the overload relay reset button on the unit to be sure the overload relay has not tripped from overload.

After Start Inspection

1. AMMETER (Optional). Needle should indicate CHARGE for a short period of time after start-up.
2. THERMOSTAT. Change the thermostat setting above and below the box temperature to check cycle sequence and switch differential (see "Operating Modes" under Unit Operation).

   NOTE: On units equipped with CYCLE-SENTRY Start-Stop controls, if the engine has not run long enough to thoroughly warm up, the unit may not shut off in the Null mode.
3. PRE-COOLING. With the thermostat set at the desired temperature, allow the unit to run for one-half to one hour (longer if possible) before loading the truck. Pre-cooling removes residual body heat and moisture from the box interior and provides a good test of the refrigeration system.
4. DEFROST. When the unit has finished pre-cooling the truck interior (box temperature dropped below 42 F [5.6 C]), initiate a defrost cycle with the manual defrost switch. Defrost cycle should terminate automatically.

Loading Procedure

1. To minimize frost accumulation on the evaporator coil and heat gain in the truck, make sure the unit is OFF before opening the doors. (Unit may be running when loading the box from a warehouse with door seals.)
2. Spot check and record load temperature while loading. Especially note any off-temperature product.
3. Load product so that there is adequate space for air circulation completely around the load. DO NOT block the evaporator inlet or outlet.

Post Load Procedure

1. Make sure all the doors are closed and locked.
2. Adjust the thermostat to the desired temperature set-point.
3. Start the unit.
4. One-half hour after loading, defrost the unit by momentarily pressing the MANUAL DEFROST switch. If the box temperature has dropped below 42 F (5.6 C), the unit will defrost. The defrost cycle should terminate automatically.

Post Trip Inspection

1. Wash the unit.
2. Check for leaks.
3. Check for loose or missing hardware.
4. Check for physical damage to the unit.

TG-V THERMOSTAT

The TG-V is a programmable microprocessor controller that uses external relays. The TG-V module is replaced as an assembly, no internal repair is available.

For complete details, see the Microprocessor Controller TG-V Operating and Setup Manual TK 40284-6.

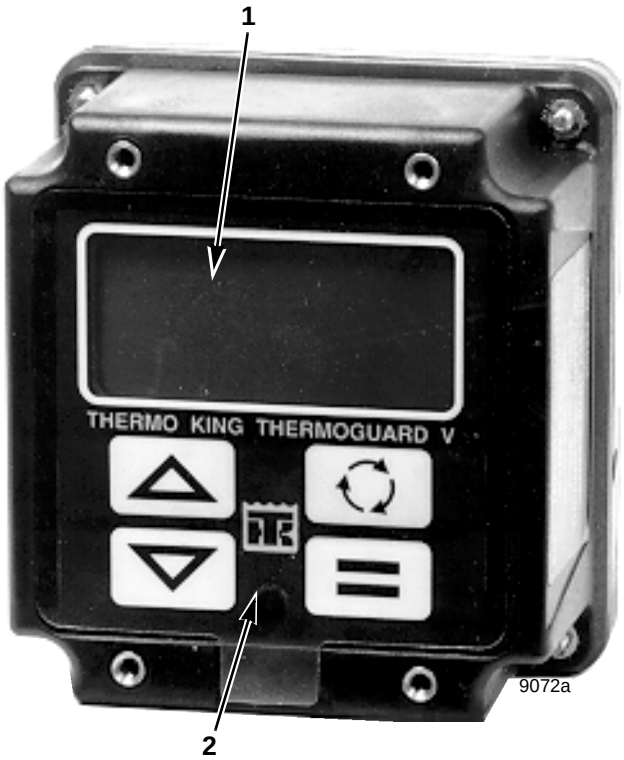
Features of the TG-V Thermostat include:

Thermometer. It displays the return air temperature, and can be programmed to display the optional discharge air temperature with 0.1 degree accuracy.

Thermostat. It provides temperature control from -20 to 80 F (-28 to 28 C), in 0.5 degree increments.

Defrost Control. When the evaporator coil is cold enough for frost to form, defrost is automatically initiated every 4 hours during pull-down until the return air temperature is in range. At in-range temperatures (between approximately 7 degrees above and 7 degrees between point), the controller is programmable for 2 to 16 hours in 2 hour increments. Defrost interval is set at the factory but can be reprogrammed by your Thermo King Dealer. It can also be programmed to terminate defrost at 30 or 45 minutes.

Fuel Saver. It can be programmed to delay high speed operation for optimum fuel economy.



1.	LCD
2.	Keypad

TG-V Thermostat

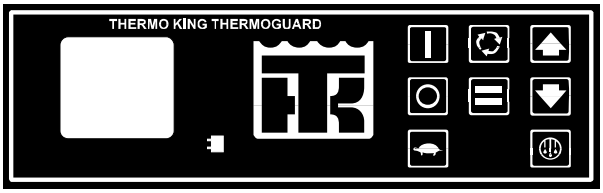
Alarm. It can detect and display up to four alarm conditions including sensor, microprocessor, and defrost termination failures.

The keypad and the Liquid Crystal Display (LCD) allow the operator to operate the TG-V. The input and output terminals on the back of the TG-V monitor unit conditions and control unit functions.

SINGLE TEMP IN-CAB TG-V CONTROLLER (OPTIONAL)

The In-Cab TG-V Controller is a microprocessor based controller that is designed to be used in Thermo King Units.

For complete details, see the In-Cab TG-V Controller Operating and Setup Manual TK 40804-8-MS.



ARA055

Single Temp In-Cab TG-V Controller

The early versions of the Single Temp In-Cab TG-V have the following part numbers:

- P/N 41-1544 - 12V No Modulation
- P/N 41-1545 - 12V Modulation
- P/N 41-1546 - 24V No Modulation
- P/N 41-1547 - 24V Modulation

The software and alarm codes were updated in the first quarter of 2000. The updated versions of the Single Temp In-Cab TG-V have the following part numbers:

- P/N 41-3305 - 12V No Modulation
- P/N 41-3306 - 12V Modulation
- P/N 41-3307 - 24V No Modulation
- P/N 41-3308 - 24V Modulation
- P/N 41-3309 - Isuzu

The face plate is P/N 91-8117 for all versions, except for Isuzu.

Interconnecting harness P/N 41-346 is used for all versions.

Features of the Single Temp In-Cab TG-V Controller include:

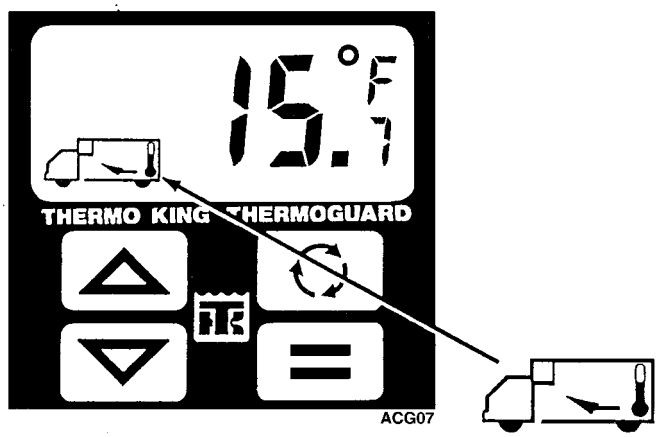
Thermometer. Displays return air temperature and (optional) discharge air temperature with 0.5 degree accuracy.

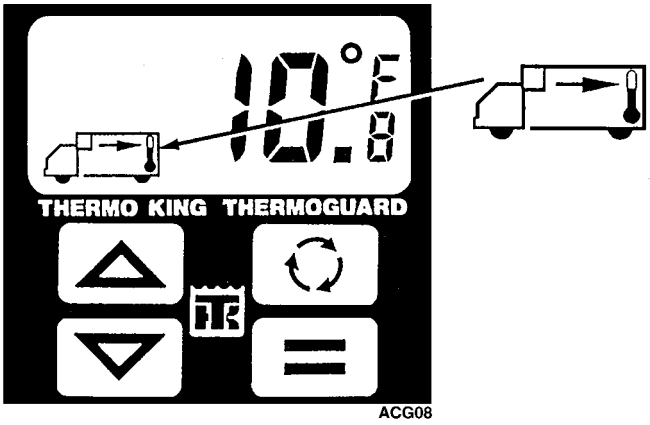
Thermostat. Provides temperature control from -20 to 80 F or -30 to 30 degrees C, in 0.5 degree increments.

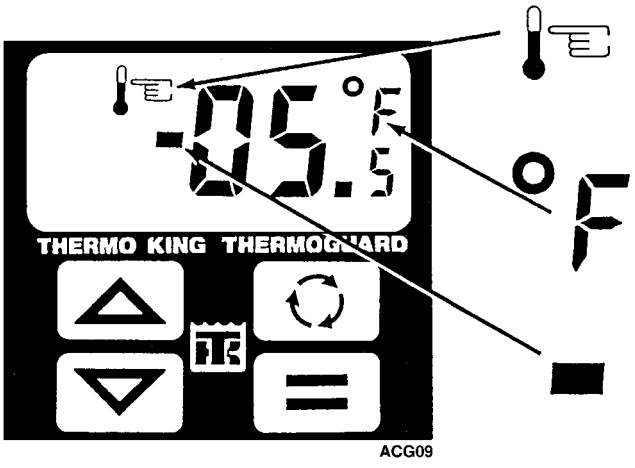
Defrost Control. When the evaporator coil is cold enough for frost to form, defrost is automatically initiated every 4 hours during pull-down until the return air temperature is in-range. At in-range temperatures (between approximately 7 degrees F [4 degrees C] above and 7 degrees F [4 degrees C] below setpoint), the controller is programmable for 1 hour or 2 to 16 hours in 2 hour increments. The defrost interval is set at the factory but can be reprogrammed by your Thermo King Dealer.

Fuel Saver. Can be programmed to delay high speed operation for optimum fuel economy.

Alarm. Can detect and display up to six alarm conditions including sensor, microprocessor, and defrost termination failures plus engine or electric standby stoppage.







DISPLAY SYMBOLS AND CONTROL KEYS

The following is a list of the display symbols and control keys on the TG-V. It is recommended that you become completely familiar with the meaning of each symbol and the function of each control key before operating the unit.

Display Symbols

Return Air Symbol

(Arrow returning from thermometer to unit.) Indicates that the return air temperature is being displayed.

Discharge Air Symbol

(Arrow from unit pointing at thermometer.) Indicates that the discharge air temperature is being displayed (optional).

Setpoint Symbol

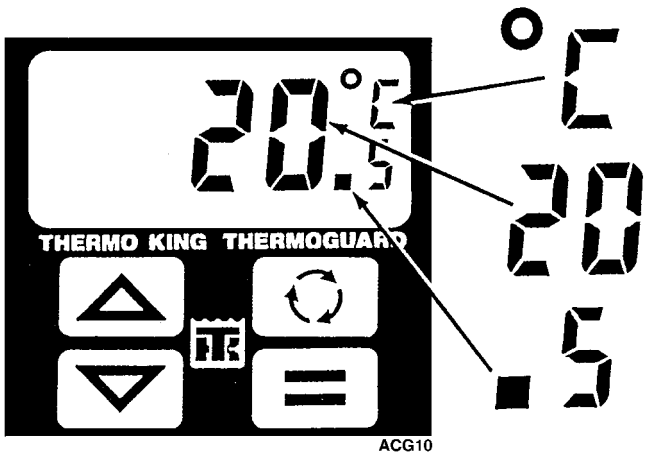
(Hand pointing to thermometer.) Indicates that the setpoint temperature is being displayed.

Fahrenheit Symbol

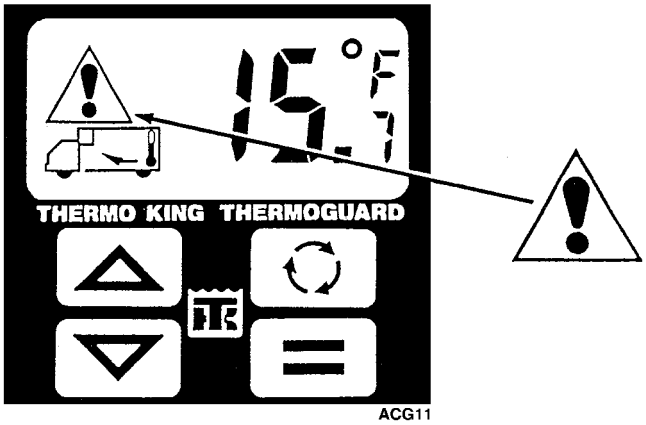
(Degree symbol and letter F.) Indicates that the temperature being displayed is in Degrees Fahrenheit.

Minus Sign

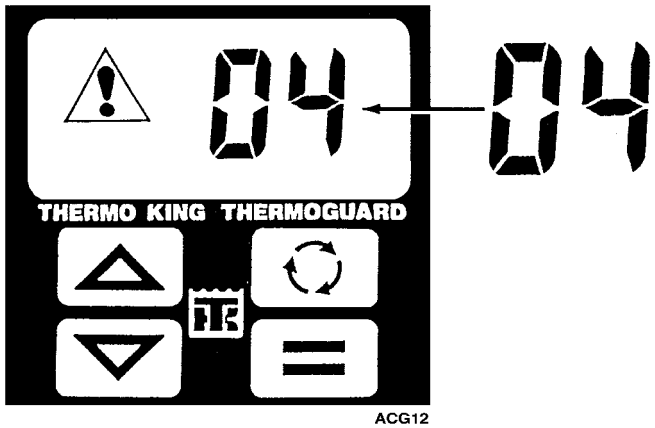
Indicates that the temperature being displayed is below zero.



ACG10



ACG11



ACG12

Display Symbols (continued)

Celsius Symbol

(Degree symbol and letter C.) Indicates that the temperature being displayed is in Degrees Celsius.

Temperature

When a temperature symbol is displayed:

- Large numbers indicate the temperature in whole degrees.
- A decimal point and 1/2 size number indicates temperature in tenths of a degree.

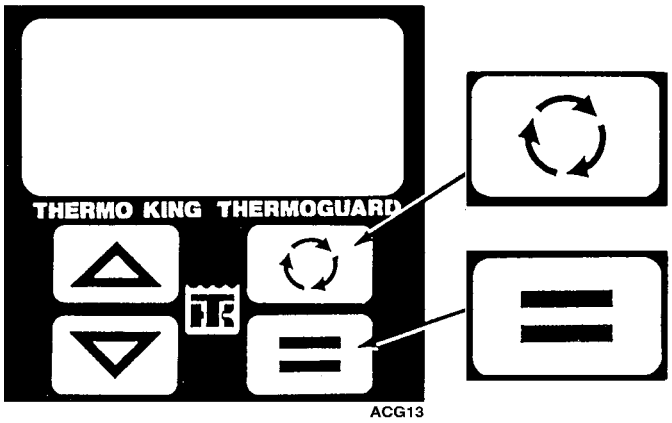
Alarm Symbol

(Exclamation point within a triangle.) When this flashing symbol is displayed, an alarm (fault) condition has been detected by the controller.

Alarm Code

When an alarm has been sensed and an alarm screen has been selected by pressing the SELECT key, this two-digit code indicates the type of alarm.

Control Keys

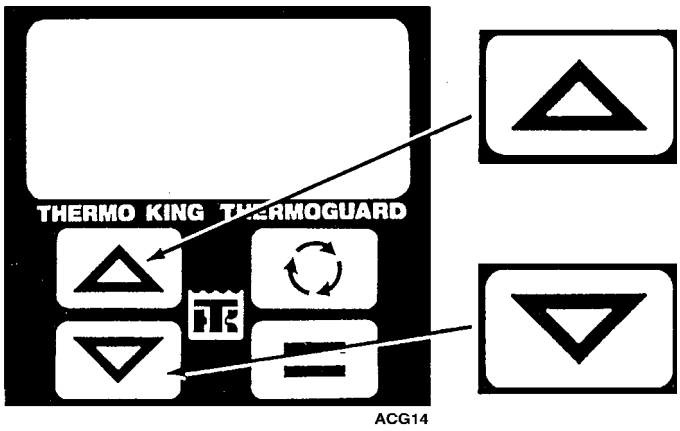


SELECT Key

(Cycling arrows) is used to select the various displays which can appear on the screen.

ENTER Key

(Equals sign) is used to enter new information into the controller.



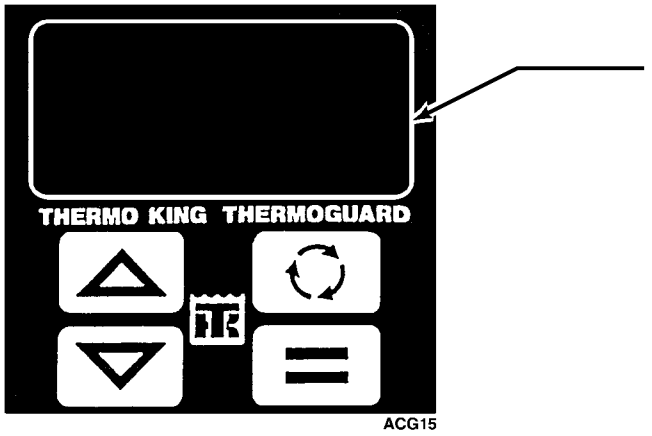
UP Key

(Arrow pointing upward) When the setpoint symbol is on the screen, this key is used to increase the setpoint temperature.

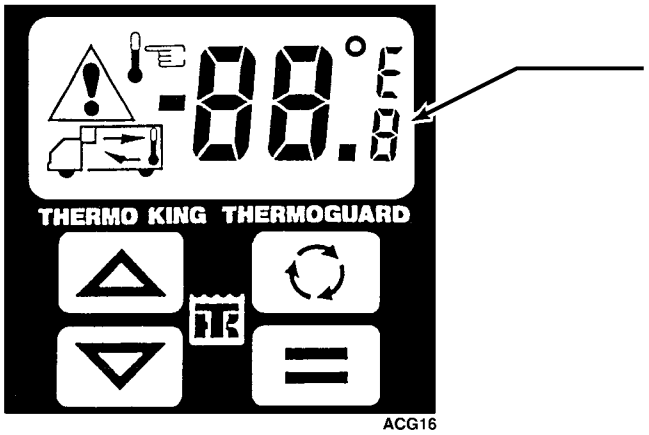
DOWN Key

(Arrow pointing downward) When the setpoint symbol is on the screen, this key is used to decrease the setpoint temperature.

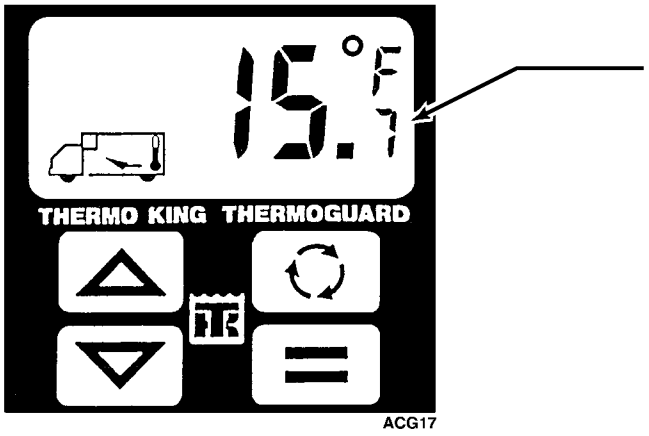
GENERAL DISPLAY INFORMATION



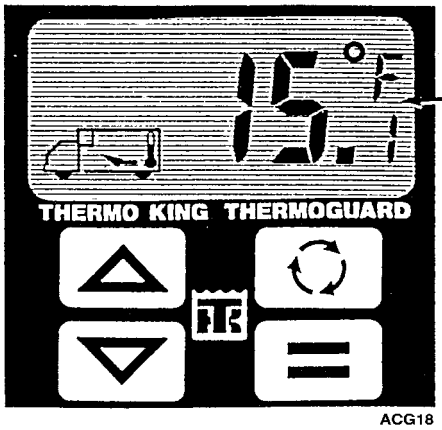
When the Thermo King unit is switched OFF, the controller screen will be dark; nothing will be on the display.



When the Thermo King unit is switched ON, all symbols and readouts will be displayed for about 5 seconds. Make sure that all display segments are operational.

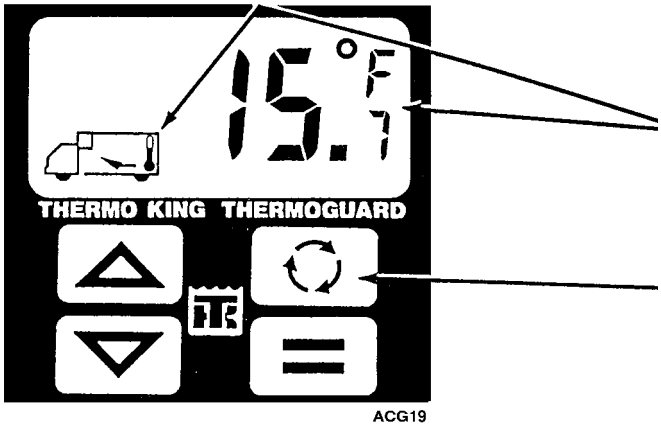


After 5 seconds the standard display will appear. This display remains on the screen during normal operation. The standard display is set to **Return Air Temperature** at the factory, however, the controller can be programmed to show Discharge Air, Return Air, or Setpoint as the standard display.



When the Thermo King unit is switched OFF, it is normal for the display to remain on for about 30 seconds as it slowly fades.

NOTE: With the power off or battery disconnected, all settings are saved in the controller memory and become active when the unit is switched ON.



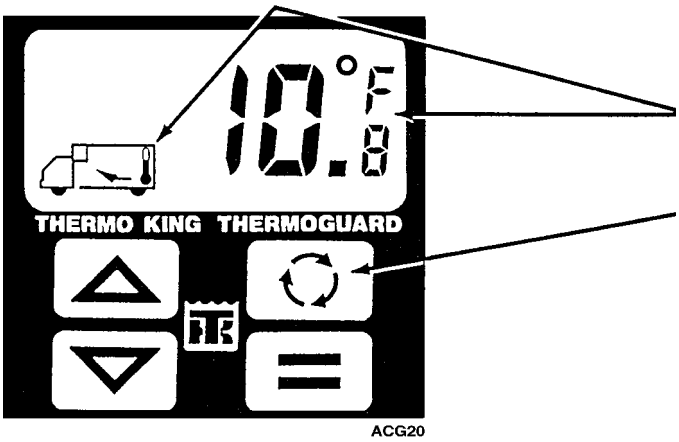
ACG19

Displaying Operating Data

During normal operation, the standard display is on the screen. **Return Air Temperature** is the factory standard display setting (this may be changed). Other operating data can also be displayed.

To view other operating data, repeatedly press and release the SELECT key.

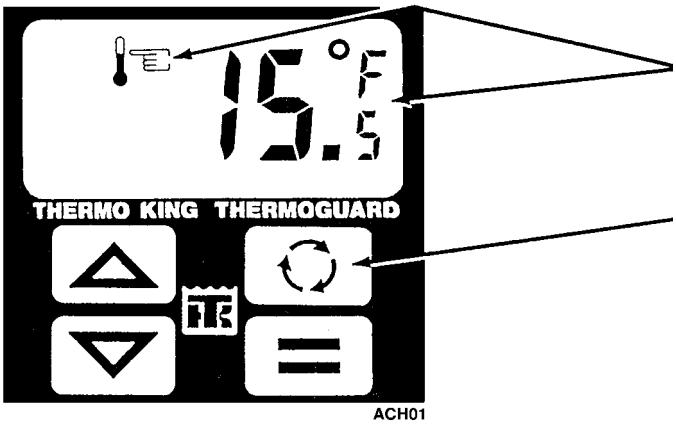
In addition to Return Air Temperature, the following data may be displayed:



ACG20

- **Discharge Air Temperature (optional**)

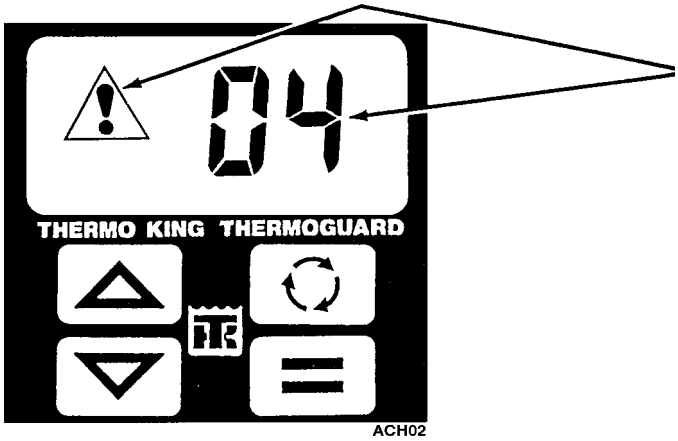
Press for next display



ACH01

- **Setpoint Temperature**

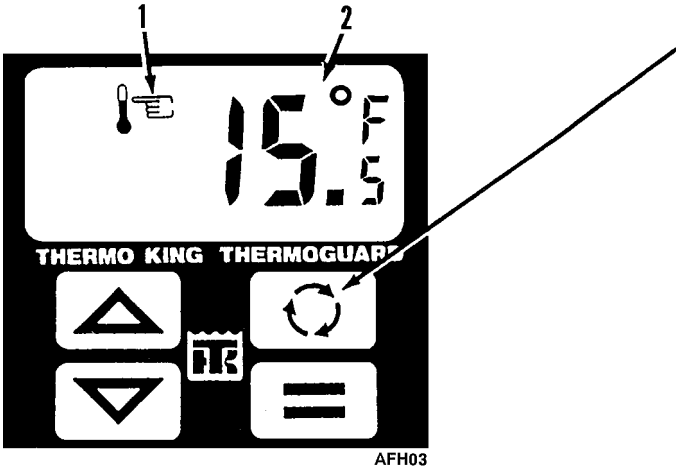
Press for next display



- **Alarms**

  (Can be displayed only when an alarm condition has been sensed by the controller)

When viewing a display...If no keys are pressed, the standard display will automatically reappear on the screen in about 10 seconds.

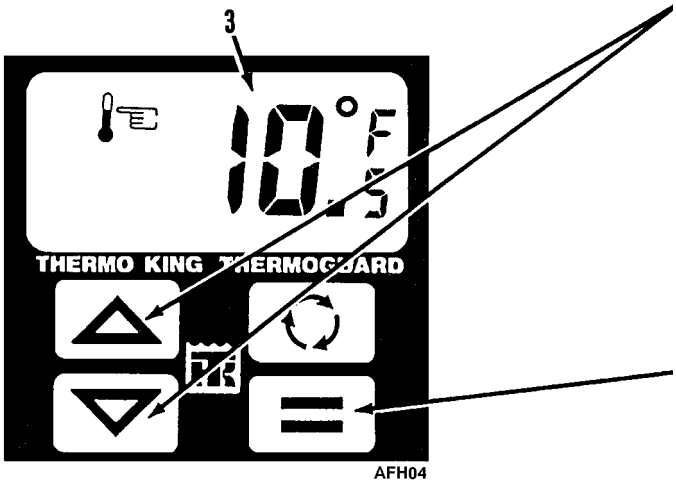


AFH03

Entering the Setpoint

The setpoint temperature of the Thermo King unit can be easily and quickly changed. To change the setpoint:

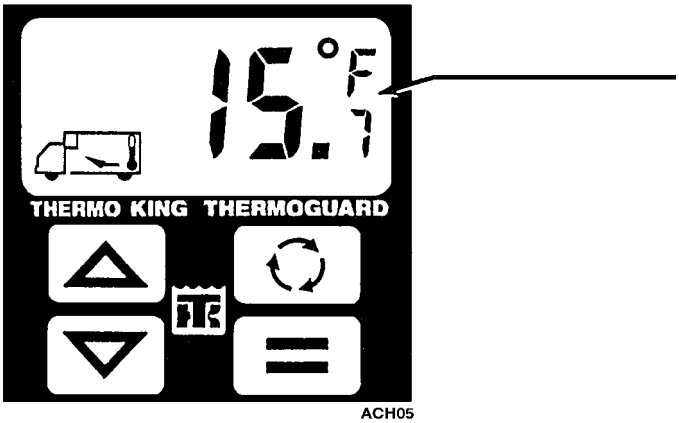
1. Press and release the SELECT key repeatedly until the setpoint symbol is on the screen.



AFH04

2. Press the UP or DOWN key until the setpoint is at the correct temperature setting.
   - Pressing and releasing either key repeatedly will cause the temperature to change by .5 degree each key press.
   - Holding either key down will cause the temperature to scroll automatically, one degree at a time.

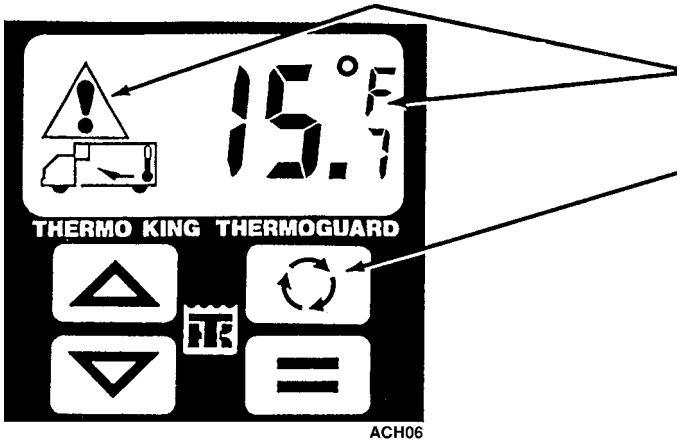
3. To enter the new setpoint into memory: Press and release the ENTER key **within 5 seconds**.
   - The display will blink once as the new setpoint is entered into memory.
   - The new setpoint will remain on the screen for about 5 seconds, then,
   - The standard screen will automatically appear.



ACH05

CAUTION: If the ENTER key is not pressed within 5 seconds: the original setpoint will appear on the screen for 5 seconds, the standard screen will automatically appear, and the Thermo King unit will be controlled at the original setpoint.

1.	Setpoint Symbol
2.	Setpoint Temperature
3.	New Setpoint Temperature



Displaying and Clearing Alarm Codes

When the TG-V controller senses an alarm condition, a flashing alarm symbol appears on the display. A two digit alarm code is used to identify the type of alarm.

1. To display the alarm code, repeatedly press and release the SELECT key until the alarm screen is displayed.

   - If more than one alarm has been sensed, all alarm codes present will automatically alternate on the screen.
   - The following alarm codes are used:

     03 Return Air Sensor Failure

     The Return Air Sensor has failed or is disconnected.

     03A Return Air Sensor Failure

     The Return Air Sensor has failed or is disconnected (Zone 2).

     04 Discharge Air Sensor Failure (Optional)

     The Discharge Air Sensor has failed or is disconnected.

     14 Defrost Circuit Failure

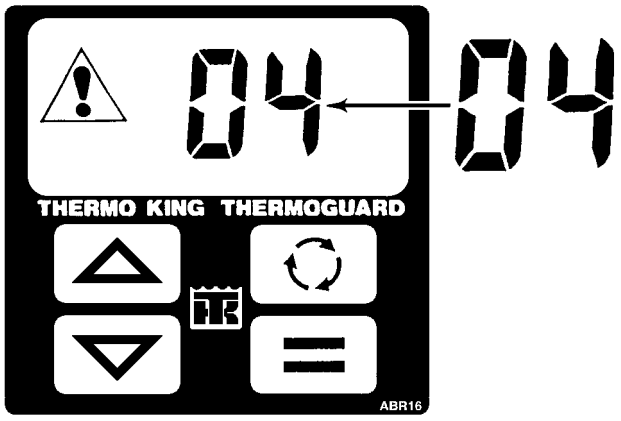
     The unit is still in defrost after the end of the defrost time limit, indicating a defrost circuit failure.

     25 Battery Charging Alternator Failure

     Current output from the unit alternator is NOT being sensed.

     29 Defrost Initiation Failure

     This code indicates that the unit attempted to enter defrost three times in rapid succession indicating a shorted air switch, shorted manual defrost switch or other defrost circuit failure.



Displaying and Clearing Alarm Codes (continued)

47 Zone 2 Evaporator Defrost Circuit Failure

Zone 2 evaporator is still in defrost after end of the defrost time limit, indicating a defrost circuit failure (No. Rh circuit).

74 Cold Start or Checksum Error

Test In-Cab TG-V with tester P/N 204-83.

75 Microprocessor RAM Faulty

Test In-Cab TG-V with tester P/N 204-83.

76 Microprocessor EEPROM Faulty

Test In-Cab TG-V with tester P/N 204-83.

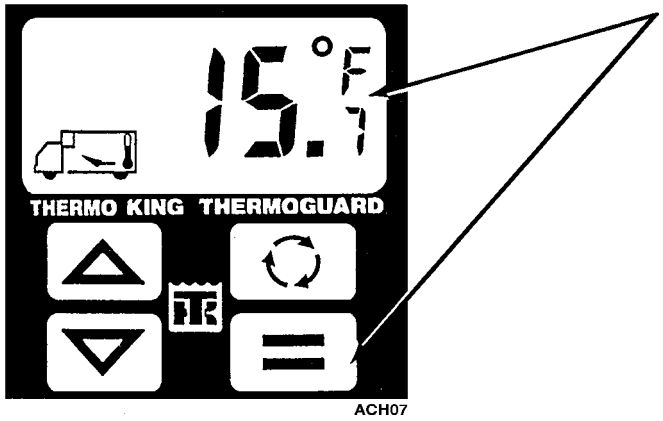
77 EPROM Faulty

Test In-Cab TG-V with tester P/N 204-83.

87 Field Test Error

88 Microprocessor Failure

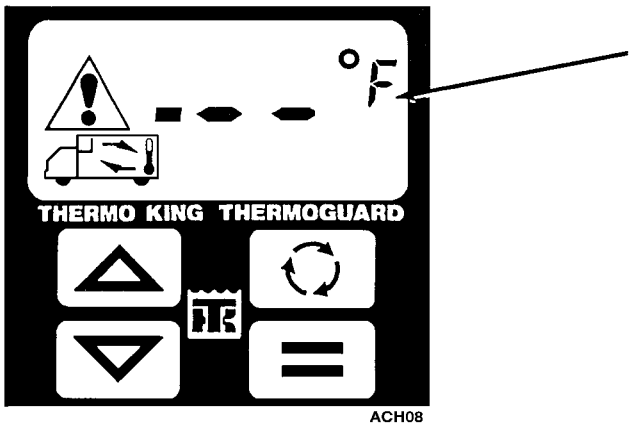
The TG-V has failed and must be replaced.



2. To clear the alarms, press the ENTER key while the alarm screen is showing. The alarms will clear and the standard display will appear on the screen.

   - Alarms may continue to appear as the unit operates if the alarm condition is not corrected.

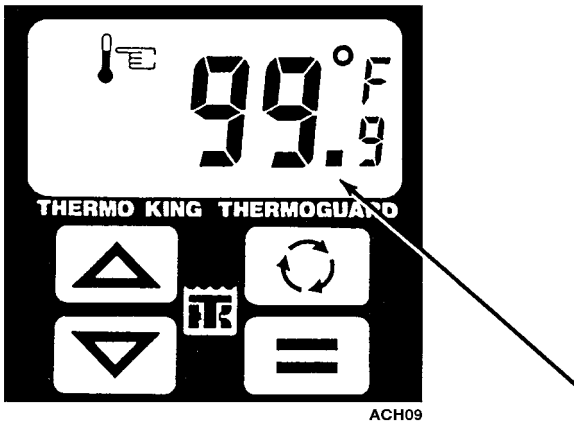
ADDITIONAL OPERATING INFORMATION



ACH08

Sensor Failure

In addition to generating an alarm, the failure of a sensor will cause the display screen for that sensor to show a minus sign and dashes in place of temperature. The alarm symbol, the minus sign and the dashes will blink continuously.



ACH09

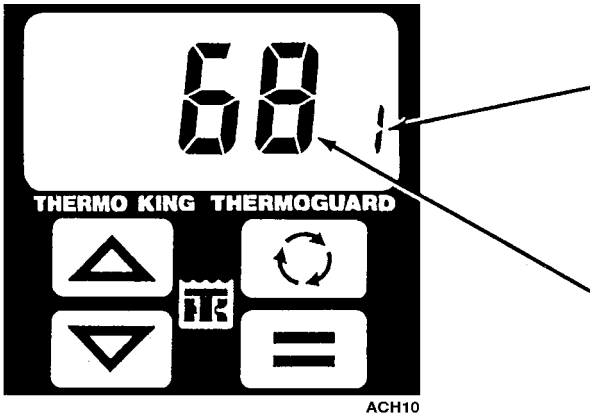
Temperatures Outside of Display Range

The Microprocessor Controller TG-V is capable of displaying temperatures ranging from -40 to 99.9 F (-40 to 37.8 C). A blinking temperature display of -40 or 99.9 F (-40 or 37.8 C) without an alarm symbol, indicates the unit is functioning normally but the temperature being sensed is outside of the display range of the controller.

Example: If the temperature in the cargo compartment were 110 F, the display would read 99.9 F (-37.8 C) and would blink continuously. The display would stop blinking once the temperature dropped below 99.9 F (-37.8 C).

GUARDED ACCESS MODE

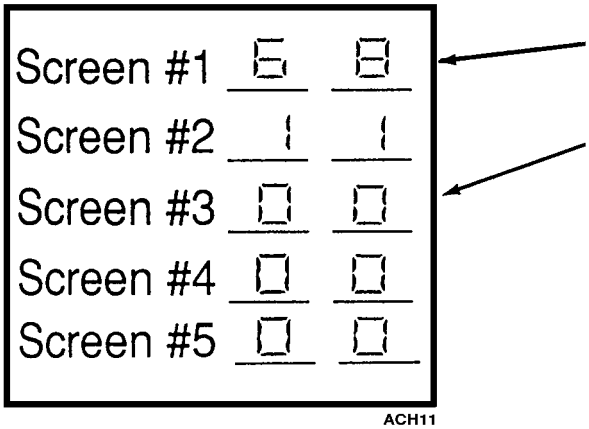
The TG-V controller is pre programmed at the factory to match the standard configuration and operating requirements of the unit.



ACH10

Thermostat Set-Up Codes

Left Digit	Right Digit		Screen
	USA	EEC	
6	8	9	1
1	1	1	2
0	0	0	3
0	0	0	4
0	1	1	5



ACH11

If the controller is being replaced, the programming set-up codes must be set to match the configuration of the unit.

The factory programming set-up codes can be found on the schematic and wiring diagrams for the unit. Special changes in the programming can be made for specific special applications.

Programming

Programming is done through the Guarded Access Mode.

The Guarded Access Mode consists of 5 screens numbered 1 through 5. Screen numbers are indicated by a 1/2 size digit.

The Microprocessor Controller is programmed by entering a two digit set-up code into each screen.

Set-up code 68 is the standard set-up code for Screen 1 on CD-II MAX (NAD) units.

Programming the controller requires the following:

- Choosing the desired set-up code for each screen.
- Entering the Guarded Access Mode.
- Changing the set-up codes as required.

Choosing Set-up Codes

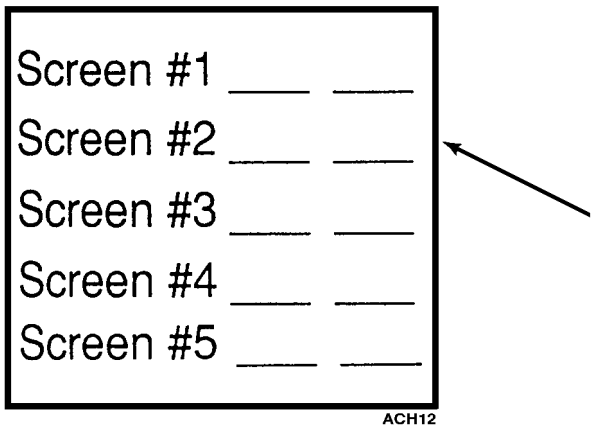
The standard set-up codes for the CD-II MAX are shown at the left.

NOTE: The set-up code for Screen 3 can be determined by checking the sensors themselves.

Each two digit set-up code can represent several operational settings of the Thermo King unit.

The factory programming set-up codes can be found on the schematic and wiring diagrams for the unit.

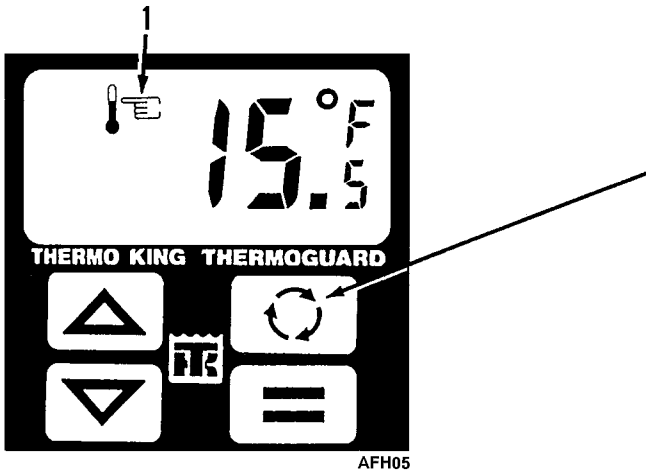
If the set-up codes are not available, they can be determined using information shown later in this chapter.



Before entering the Guarded Access Mode or changing set-up codes:

1. Choose the set-up codes for each screen.

2. Write the set-up codes in the space provided or on a separate piece of paper.



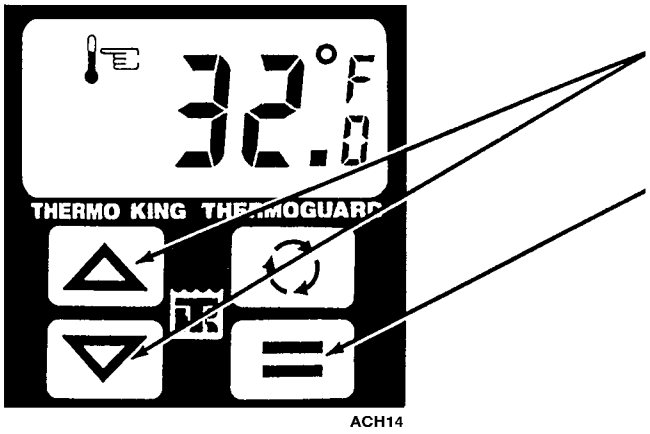
1.	Setpoint Symbol

Entering the Guarded Access Mode

To get to the Guarded Access Mode:

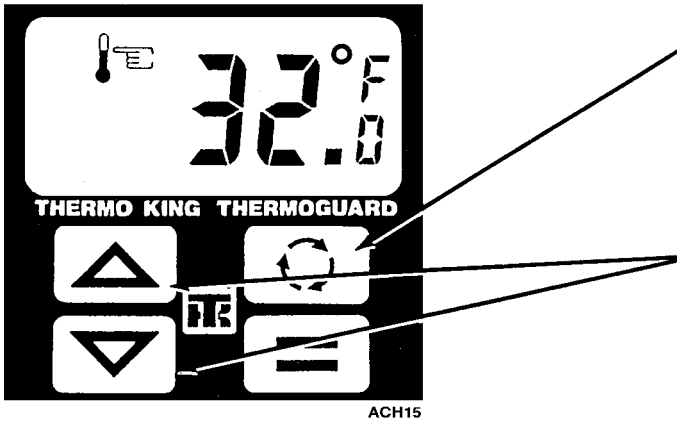
1. Press and release the SELECT key repeatedly until the setpoint symbol is on the screen.

   NOTE: Record the setpoint so that the unit may be returned to the original setting when programing is finished.



2. Press the UP or DOWN key until the setpoint is at exactly 32.0 F or 0.0 C.

3. Press and release the ENTER key within 5 seconds to enter the setpoint into the controller.

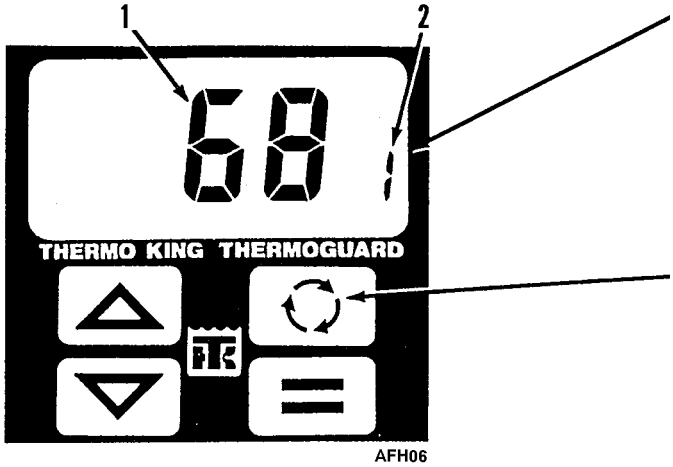


ACH15

4. Press the SELECT key until the setpoint symbol is again on the screen. However, this time, when the setpoint symbol comes on the screen, DO NOT release the SELECT key, hold it down.

5. While holding down the SELECT key, press the UP key and the DOWN key **at the same time**.

- Screen 1 in the Guarded Access Mode will appear.

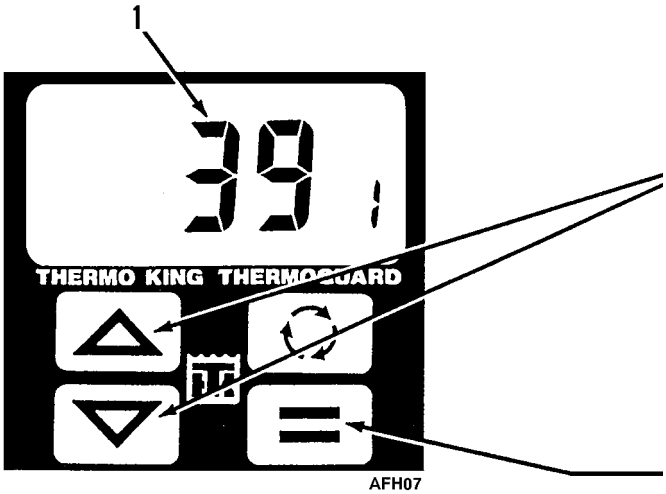


AFH06

To select other Guarded Access screens, press and release the SELECT key until the desired screen is on the display.

If no keys are pressed, the standard display will automatically reappear on the screen in about 10 seconds.

1.	Current Setup Code
2.	Screen Number



1.	New Set-up Code

Changing Set-Up Codes

To change the set-up code:

1. With a Guarded Access screen on the display, press the UP key or the DOWN key repeatedly until the desired code is on the screen.

   NOTE: Display digits cannot be set individually. The UP or DOWN key is used to "scroll" the display until the correct two digit code is on the screen.

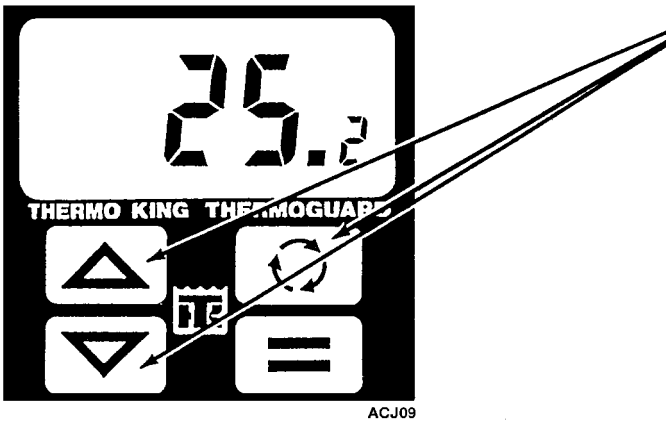
2. To enter the new set-up code into memory:

   Press and release the ENTER key **within 5 seconds**.

   - The display will blink once as the new code is entered into memory.
   - The new code will remain on the screen for about 5 seconds and then,
   - The standard screen will automatically appear.

or

   - You may go to another Guarded Access screen by pressing and releasing the SELECT key within 5 seconds of entering the new code. To change the set-up code on other screens, repeat steps 1 and 2.



CAUTION: If the ENTER key is not pressed within 5 seconds: the original set-up code will appear on the screen for 5 seconds, the standard screen will automatically appear, and the controller will operate with the original set-up code for that screen.

NOTE: Remember to return the controller to the original setpoint when programming is finished.

Screen 1

The set-up code for Screen 1 represents a combination of the following seven settings:

1. **Save Elapsed Time**

   Elapsed time is the duration between the end of one defrost cycle and the beginning of the next.

   The TG-V Microprocessor Controller has a built in defrost interval timer which can automatically initiate a defrost cycle after a preset period of time has elapsed.

   When the Thermo King unit is switched OFF, the defrost interval timer can be set to do one of two things:

   - It can save the time which has elapsed since the last defrost and continue on when the unit is restarted.
   - Or, it can reset and start timing again from the beginning.

   Example: Defrost interval time is set to 2 hours. The unit is switched OFF after 1 hour (that is, a defrost interval of 1 hour has elapsed):

   - If the elapsed time HAS been saved; when the unit is turned back ON, the timer could initiate defrost 1 hour later. The total interval is 1 hour of elapsed time plus 1 hour of time since the unit was turned ON.
   - If the elapsed time HAS NOT been saved; when the unit is turned back ON, the timer will reset and start timing again from the beginning. The timer could initiate defrost 2 hours from the time the unit was turned back ON.

   The Microprocessor Controller should be set to save elapsed time:

   - In delivery applications where the unit will be turned ON and OFF before a normal defrost time has elapsed.
   - In units without an air switch.

   Elapsed time should **NOT** be saved in normal, over-the-road applications where the unit is run continuously and is not frequently turned OFF and ON.

   Settings:

   YES = Save elapsed time.

   NO = Do not save elapsed time.

2. **Defrost Terminate Time**

   If a defrost cycle is not terminated automatically, the TG-V Microprocessor Controller terminates the defrost cycle after the programmed period of time.

   Settings:

   30 minutes or 45 minutes.

3. **High Speed Delay**

   To save fuel when the cargo compartment temperature is in range, the TG-V Microprocessor Controller can delay high speed heat or high speed cool for 8 minutes.

   Settings:

   YES = Delay high speed operation for 8 minutes.

   NO = Do not delay high speed operation for 8 minutes.

   NOTE: In order for the High Speed Delay to operate, the 7K terminal must be used.

   NOTE: Low Speed heat is only available in Continuous Run operation. In CYCLE-SENTRY, the unit restarts and runs in High Speed Heat.

Screen 1 (continued)

4. **High Speed Heat Lockout**

   To protect frozen foods, the TG-V can lockout high speed heat when the setpoint is below 15 F (-9.4 C).

   Settings:

   YES = Lockout high speed heat below 15 F (-9.4 C).

   NO = Do not lockout high speed heat below 15 F (-9.4 C).

5. **Fahrenheit/Celsius**

   The TG-V can display temperatures in either Fahrenheit or Celsius.

   Settings:

   F = Fahrenheit

   C = Celsius

   Directions for choosing the set-up codes for Screen 1 are on the next page.

6. **Discharge Sensor**

   When an optional discharge air sensor is connected to the TG-V, the discharge air temperature can be displayed.

   Settings:

   YES= Discharge sensor connected, display discharge air temperature.

   NO = Discharge sensor not connected, do not display discharge air temperature.

   NOTE: If the unit does not have a discharge air sensor, but the discharge sensor setting is set to "YES", the controller will display an alarm symbol and the alarm screen will show alarm 04 (Discharge Air Sensor Faulty). Instead of showing a temperature, the discharge air screen will display dashes.

7. **Modulation Valve**

   The TG-V can control Thermo King units which are equipped with a modulation valve.

   Settings:

   YES = Unit has a modulation valve.

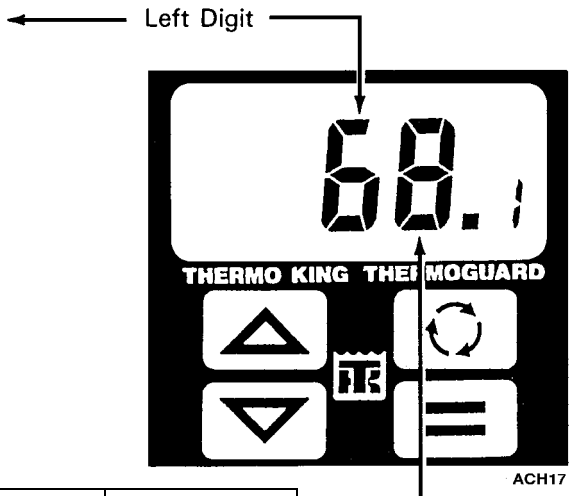
   NO = Unit does not have a modulation valve.

   NOTE: Units with a modulation valve must have a discharge air sensor connected to the controller.

   If the sensor is not connected, the controller will display an alarm symbol and the alarm display will show alarm 04 (Discharge Air Sensor Faulty).

Set-up Code—Screen #1

Save Elapsed Time	Defrost Terminate Time	High Speed Delay	Code
No	30 min	No	0
No	30 min	Yes	1
No	45 min	No	2
No	45 min	Yes	3
Yes	30 min	No	4
Yes	30 min	Yes	5
Yes	**45 min**	**No**	**6**
Yes	45 min	Yes	7



Directions: To determine the two digit set-up code for Screen #1:

1. Select the code number that matches the correct combination of settings from the top table. This becomes the left digit.
2. Select the code number that matches the correct combination of settings from the bottom table. This becomes the right digit.

NOTE: Factory standard settings are in bold type.

High Speed Heat Lockout	Discharge Sensor	Modulation Valve	Fahrenheit/ Celsius	Code
No	No	No	F	0
No	No	No	C	1
No	No	Yes	F	2
No	No	Yes	C	3
No	Yes	No	F	4
No	Yes	No	C	5
No	Yes	Yes	F	6
No	Yes	Yes	C	7
Yes	**No**	**No**	**F**	**8**
Yes	No	No	C	9
Yes	No	Yes	F	A
Yes	No	Yes	C	B
Yes	Yes	No	F	C
Yes	Yes	No	C	D
Yes	Yes	Yes	F	E
Yes	Yes	Yes	C	F

Right Digit

Screen #2

Defrost intervals are set with Screen #2. A defrost interval is the period of time between the end of one defrost cycle and the beginning of the next.

During pull-down the defrost interval is 4 hours. Once the unit is in-range, the defrost interval becomes the interval set with this screen.

Defrost Time Interval Above Lockout

Sets the defrost interval for setpoint temperatures above 15 F (-9.4 C).

Settings:

2, 4, 6, 8, 10, 12, 14 or 16 hours

Defrost Time Interval Below Lockout

Sets the defrost interval for setpoint temperatures below 15 F (-9.4 C).

Settings:

2, 4, 6, 8, 10, 12, 14 or 16 hours

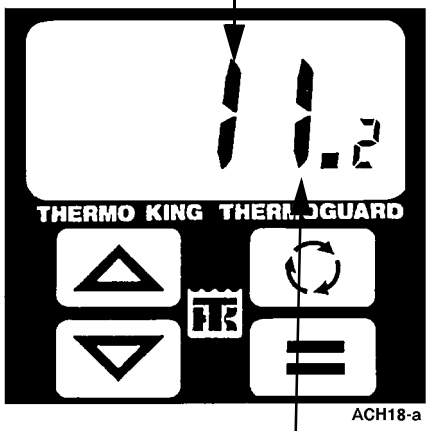
Directions for choosing the set-up codes for Screen #2 are on the next page.

NOTE: The 1 hour defrost interval is provided for checking the system and is not intended as a practical defrost interval.

Set-Up Code—Screen #2

Defrost Time Above Lockout	Code
2 Hours	0
4 Hours	**1**
6 Hours	2
8 Hours	3
10 Hours	4
12 Hours	5
14 Hours	6
16 Hours	7
1 Hour	8

Left Digit



Directions: To determine the two digit set-up code for Screen #2.

1. Select the code number that matches the correct setting from the top table. This becomes the left digit.
2. Select the code number that matches the correct setting from the bottom table. This becomes the right digit.

NOTE: Factory standard settings are listed in the wiring and schematic diagrams for each unit.

Defrost Time Below Lockout	Code
2 Hours	0
4 Hours	**1**
6 Hours	2
8 Hours	3
10 Hours	4
12 Hours	5
14 Hours	6
16 Hours	7
1 Hour	8

Right Digit

Screen #3

For accuracy, the Microprocessor Controller must be adjusted to match the unit sensors. That adjustment is done with Screen #3.

There are two types of sensors, graded and ungraded.

Graded sensors are measured and presorted at the factory into categories (grades) based on their electrical resistance. They are marked with grades 1 through 5. Graded sensors, regardless of grade number, are accurate to within ±.125 degrees.

Ungraded sensors are not sorted and therefore have a wider possible range of resistance. They do not have grading marks and are accurate to ±.6 degrees.

The TG-V Microprocessor Controller can be calibrated to work with either type of sensor.

For graded sensors, set the controller to match the grade of the sensor. Example: for a grade 4 sensor, the controller setting would be 4.

For ungraded sensors, set the controller to grade 0.

Directions for choosing the set-up codes for Screen #3 are on the next page.

Discharge Sensor Grade (Optional)

Matches controller operation to the grade of the discharge air sensor.

Settings:

Grades 0, 1, 2, 3, 4, or 5

Return Sensor Grade

Matches controller operation to the grade of the return air sensor.

Settings:

Grades 0, 1, 2, 3, 4, or 5

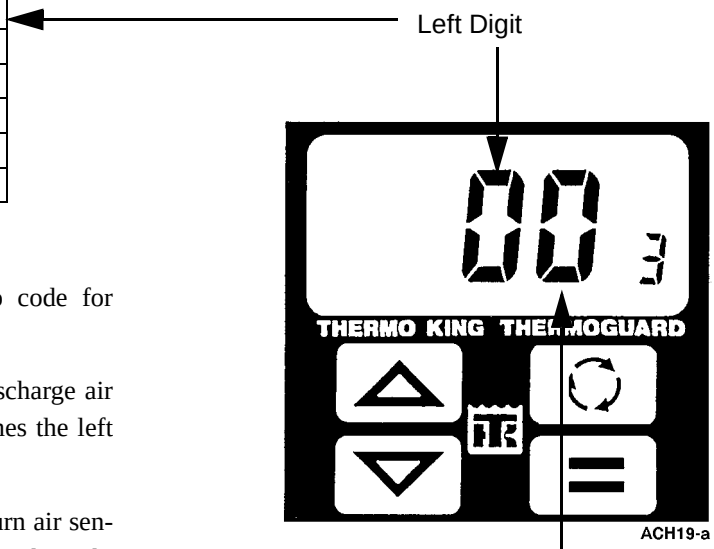
NOTE: An ungraded sensor can be partially graded by immersing the sensor in a good ice bath and then selecting various sensor grades until the return air (or discharge air) temperature reads 32.0 F (or 0.0 C). The sensor may then be accurate for freezing temperature but may not be accurate towards either extreme of the controller range.

NOTE: When return air and discharge air sensors are used with a modulation control valve, graded sensors must be used. Without modulation, the use of graded sensors is optional.

NOTE: The return air sensor is the primary control sensor and must be connected at all times.

Set-Up Code—Screen #3

Discharge Sensor Grade	Code
0	**0**
1	1
2	2
3	3
4	4
5	5



Directions: To determine the two digit set-up code for Screen #3.

1. Select the code number that matches the discharge air sensor grade from the top table. This becomes the left digit.
2. Select the code number that matches the return air sensor grade from the bottom table. This becomes the right digit.

NOTE: Factory standard settings are listed in the wiring and schematic diagrams for each unit.

Return Sensor Grade	Code
0	**0**
1	1
2	2
3	3
4	4
5	5

Screen #4

The “standard display” is set with Screen #4.

Standard Display

The standard display normally appears on the screen. The screen automatically returns to the standard display when viewing of other screens is complete and no keys are pressed for about 10 seconds.

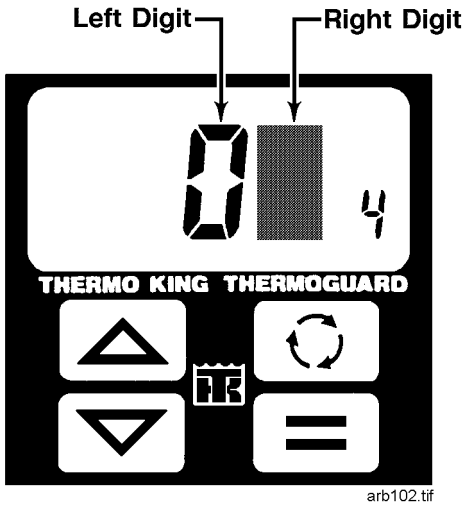
Settings:

- Return Air Temperature
- Setpoint Temperature
- Discharge Air Temperature (optional).

NOTE: This screen is available only when the Discharge Sensor setting (Screen #1) is set to YES.

- Alternate between Return Air Temperature and Setpoint Temperature (Return Air 30 seconds, Setpoint 5 seconds).
- Alternate between Discharge Air Temperature and Setpoint Temperature (Discharge Air 30 seconds, Setpoint 5 seconds). This screen is available only when the Discharge Sensor setting (Screen #1) is set to YES, and the discharge sensor is installed.

NOTE: This screen is available only when the Discharge Sensor setting (Screen #1) is set to YES.



w/o “dF” Indicator

NOTE: The Left Digit is always zero.

Directions: To determine the two digit set-up code for Screen #4.

- Select the code number that matches the correct standard display. The LEFT digit of the code number becomes the LEFT digit on the screen. The RIGHT digit of the code number becomes the RIGHT digit on the screen.

NOTE: Factory standard settings are listed in the wiring and schematic diagrams for each unit.

DEFROST Model Display

The purpose of this modification is to allow the default display to include a periodic indication that the system is in the DEFROST mode.

The new selections possible on Guarded Access Screen 4 are as follows:

Default Display	Screen 4 Selection	
	Left Digit Code	Right Digit Code
Return Air Temperature	0	0
Setpoint Temperature	00	1
Discharge Air Temperature	00	2
Alternate Return Air Temperature and Setpoint Temperature	00	3
Alternate Discharge Air Temperature and Setpoint Temperature	00	4

Screen #5

The set-up code for Screen #5 represents a combination of the following settings:

High Speed (Cool) Pull-Down

This feature provides faster temperature Pull-Down for critical cargos.

At start-up:

- In Continuous Run or CYCLE-SENTRY, to reduce the time needed to bring cargo box temperature down to setpoint (Pull-Down), the unit will operate in High Speed Cool until the return air temperature reaches setpoint.
- Once the return air temperature reaches setpoint:
  - — Units operating in Continuous Run will switch to low speed cool for five seconds then to low speed heat. The unit will then cycle between low speed heat and low speed cool as necessary.
  - — Units operating in CYCLE-SENTRY will switch to low speed cool for five seconds to allow Battery Sentry to check the charging current. If the battery is charged, the unit is not in defrost and the engine block is sufficiently warm, the unit will shut-down, restarting as necessary. If not, the unit will continue to run switching from low speed heat to low speed cool as necessary.

As operation continues:

- In Continuous Run or CYCLE-SENTRY, if setpoint has not been reached in eight minutes while running low speed cool, the unit will switch to high speed cool, driving the return air temperature back down to setpoint.
- If the unit has been running in low speed cool for less than eight minutes and the return air temperature reaches setpoint:
  - — Units operating in Continuous Run will switch to low speed heat changing to low speed cool as necessary.
  - — Units operating in CYCLE-SENTRY will shut down, restarting as necessary.
- In Continuous Run or CYCLE-SENTRY, if the return air temperature reaches 5.1 F (2.8 C) degrees above setpoint, the unit will immediately switch to high speed cool, unless the Fuel Saver 8 minute Delay to High Speed is active.

NOTE: High Speed Pull-Down will be inactive in units with modulation that are operating in Continuous Run above 15 F (-9C).

High Speed Pull-Down Fresh

The controller can initiate a High Speed Pull-Down to setpoint of fresh loads above 15 F (-9.4 C).

Settings:

YES = Enable High Speed Pull-Down to setpoint.

NO = Normal operation. Do not enable high speed pull-down to setpoint.

High Speed Pull-Down Frozen

The controller can initiate a High Speed Pull-Down to setpoint of frozen loads at or below 15 F (-9.4 C).

Settings:

YES = Enable High Speed Pull-Down to setpoint.

NO = Normal operation. Do not enable High Speed Pull-Down to setpoint.

2 Minute Low Speed Start (Continuous Run only)

This setting allows the engine to warm-up by running it in low speed for 2 minutes when the unit is first started. After 2 minutes, the unit will resume normal operation.

This setting functions only while the unit is operating in Continuous Run.

Settings:

YES = Enable 2 minute low speed start.

NO = Normal operation. Do not enable 2 minute low speed start.

Reduced Setpoint Range

Smaller truck units are not designed to operate with a setpoint range of -20 to 80 F (-28 to 28 C). For these units the setpoint range must be reduced to 0 to 80 F (-18 to 28 C).

This setting is programmed at the factory. Change it only when replacing the controller, and then only to the original factory setting for your unit.

Settings:

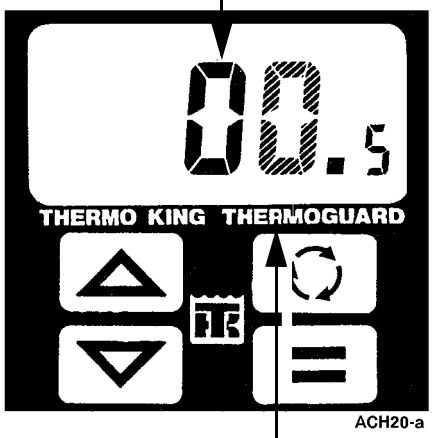
YES = Reduce setpoint range to 0 to 80 F (-18 to 28 C).

NO = Do not reduce setpoint range.

Set-Up Code—Screen #5*

Code
0

Left Digit



ACH20-a

Directions: To determine the two digit set-up code for Screen #5:

1. Left digit code number is always 0 for this screen.
2. Select the code number that matches the correct combination of settings from the bottom table. This becomes the right digit.

NOTE: Factory standard settings are listed in the appropriate wiring and schematic diagrams for each unit.

High Speed Pull-Down Fresh	High Speed Pull-Down Frozen	2 Minute Low Speed Start*	Reduced Setpoint Range	Code
No	No	No	F	0
No	No	No	Yes	1
No	No	Yes	No	2
No	No	Yes	Yes	3
No	Yes	No	No	4
No	Yes	No	Yes	5
No	Yes	Yes	No	6
No	Yes	Yes	Yes	7
Yes	No	No	No	8
Yes	No	No	Yes	9
Yes	No	Yes	No	A
Yes	No	Yes	Yes	b
Yes	Yes	No	No	C
Yes	Yes	No	Yes	d
Yes	Yes	Yes	No	E
Yes	Yes	Yes	Yes	F

Right Digit

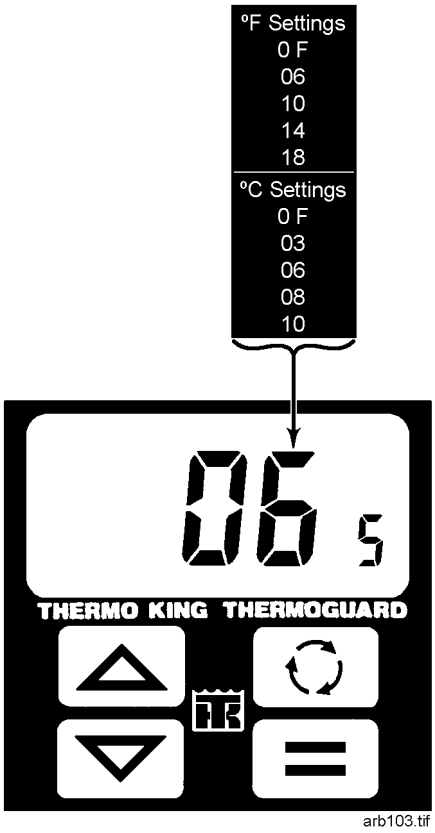
**** Functions in Continuous Run only***

In-Range Temperature Differential Setting

The In-Range Temperature Differential Setting is set with Screen 5. This setting determines the range used in monitering in-range and out of range conditions.

The following settings are available for Fahrenheit or Celcius readouts:

- Fahrenheit: 0.0 F (OFF), 6, 10, 14, and 18 degrees
- Celsius: 0.0 F (OFF), 3, 6, and 10 degrees



In-Range Temperature Differential Setting

Directions:

To determine the setting for Screen 5, choose the temperature differential desired for the in-range temperature interval.

Example:

To set an in-range temperature differential of 6 degrees above and below the setpoint, select the number 6.

NOTE: The settings available automatically correspond to the scale (F or C) chosen in Display 1.

TESTING THE TG-V THERMOSTAT

Tools and Materials Required for Testing

1. Volt/ohm meter capable of accurately reading 1/100 volt increments.
2. Jumper Wires
3. Three Relays, Part No. 44-5847
4. One 12 Vdc Power Supply
5. Mercury Thermometer

TG-V Calibration

The TG-V thermostat is permanently calibrated, and no attempt should be made to recalibrate it. The thermostat module is a non-serviceable item and repairs should not be attempted. If the thermostat is found to be defective, replace it.

Ice-Water Bath Preparation

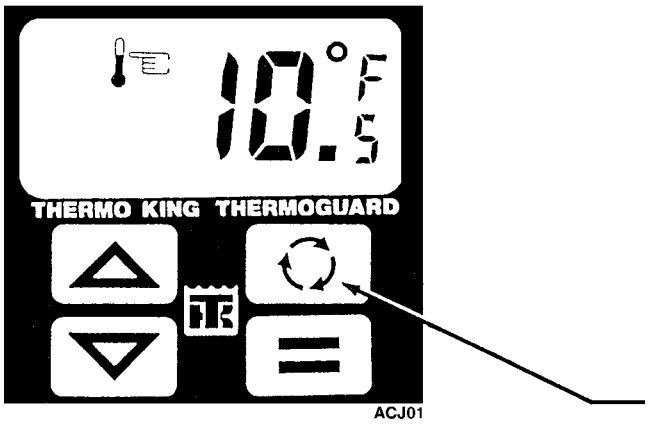
1. Fill an insulated container full of ice. Add enough water to cover the top of the ice during the test procedure.
2. Remove the sensor bulb from the unit or use a known good sensor for testing the thermostat module.
3. Stir the ice-water bath for one minute or until stabilized at 32 F (0 C).
4. Monitor the ice-water bath temperature with a mercury thermometer during testing to ensure test accuracy.

NOTE: Before testing a questionable thermostat module, it is a good idea to check the thermostat sensor first.

Sensor Test

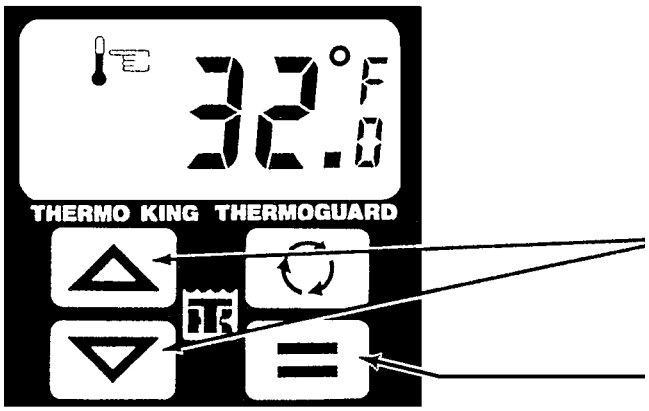
1. Visually check the bulb end, lead, and terminal end of the sensor. Make sure that it is not damaged.
2. Using an ohmmeter capable of reading at least 4000 ohms, check resistance between the sensor leads.
3. Sensor resistance should be approximately 3000 to 3500 ohms. Use the following method to give the sensor a more accurate test:
   a. Cool the sensor down to 32 F (0 C) and check the resistance—reading should be 3266 ± 3.4 ohms.
   b. Warm the sensor up to 70 F (21.1 C) and check the resistance—reading should be 3450 ± 6.9 ohms.
4. If the sensor does not meet specifications, replace it.
5. If the sensor does meet specifications, proceed to TG-V thermostat bench test.

Preparing TG-V Module for Bench Test



ACJ01

1. Place the unit ON/OFF switch in the ON position. (If the thermostat module is out of the unit, this can be accomplished by connecting a 12 Vdc power source to the 8 and CH terminals, 8 is connected to positive (+) and CH is connected to negative (-).

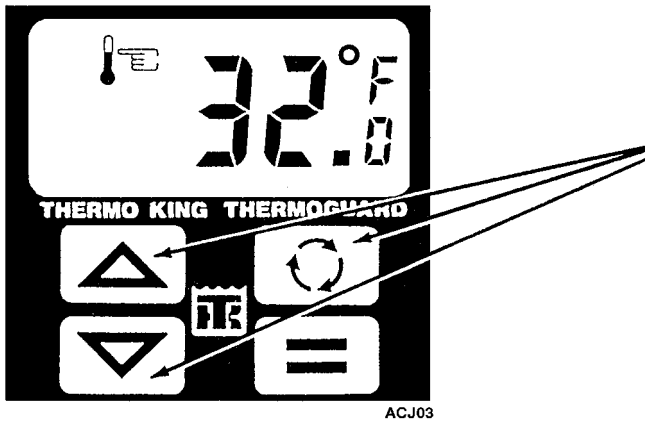


ACJ02

2. Press and release the SELECT key repeatedly until the setpoint symbol is on the screen.

3. Press the UP and DOWN key until the setpoint is at exactly 32 F or 0 C.

4. Press the ENTER key (within 5 seconds) to enter this setpoint.

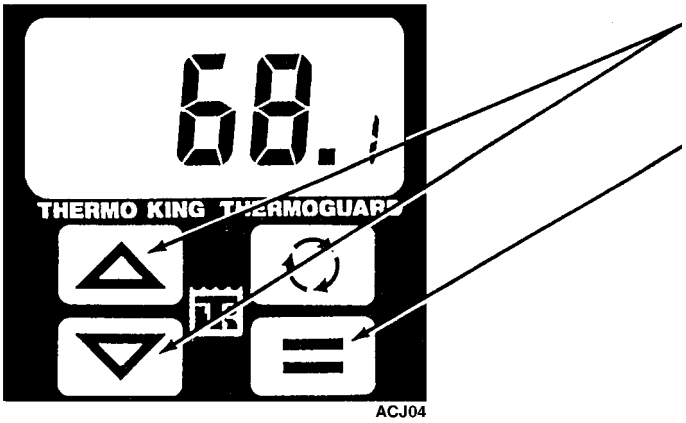


ACJ03

5. With the setpoint temperature at 32 F or 0 C, press the UP key, the DOWN key and the SELECT key **at the same time**.

   - Screen #1 in the Guarded Access Programming Mode will appear.

   NOTE: Pressing the three keys at the same time can be difficult. If it does not work the first time, return to the setpoint screen with the setting at 32 F or 0 C and try again. It may take several attempts.



Preparing TG-V Module for Bench Test (continued)

6. Press the UP or DOWN key until the set-up code on Screen #1 reads 68.

7. Press the ENTER key.

If no keys are pressed, the standard display will automatically reappear on the screen in about 10 seconds.

TG-V Module Bench Test

1. Place the main ON/OFF switch in the OFF position.
2. Disconnect all of the wires from the thermostat module.
3. Connect a known good sensor (yellow jacketed) to the terminals labelled SN on the rear of the thermostat module.
4. To obtain accurate voltage readings during the thermostat module checkout, circuits 10T and 14T must be tested under normal load. This is provided by connecting two Bosch relays (Part No. 44-5847) as follows:

   Connect pin 86 of two relays to the negative (-) terminal of a 12 Vdc power source. Connect pin 85 of one relay to the 10T terminal to simulate the speed relay. Connect pin 85 of the second relay to the 14T terminal to simulate the heat relay.
5. Place the sensor bulb in a 32 F (0 C) ice bath.
6. Connect the positive (+) 12 Vdc power source on the 8 terminal. Connect the negative (-) power source to the CH terminal.
7. Check for voltage between 8 and CH. Make sure approximately 12 volts is present.

   NOTE: Due to the accuracy of the TG-V module, the digital readout may read a few tenths of a degree higher than 32 F (0 C).
8. Set the thermostat module setpoint to 24 F (4.4 C). The thermostat is now in high speed cool.
   a. Check for voltage between terminals 10T and CH. 12 volts should be present. The speed relay should be energized.
   b. Check for voltage between terminals 14T and CH. Zero volts should be present. The heat relay should be de-energized.
9. Set the thermostat module setpoint to 29 F (-1.7 C). The thermostat is now in low speed cool.
   a. Check for voltage between terminal 10T and CH. Zero volts should be present. The speed relay should be de-energized.
   b. Check for voltage between terminals 14T and CH. Zero volts should be present. The heat relay should be de-energized.
10. Set thermostat module setpoint to 33 F (0.6 C). The thermostat is now in low speed heat.
    a. Check for voltage between terminals 10T and CH. Zero volts should be present. The speed relay should be de-energized.
    b. Check for voltage between terminals 14T and CH. 12 volts should be present. The heat relay should be energized.
11. Set the thermostat module setpoint to 36 F (2.2 C). The thermostat is now in high speed heat.
    a. Check for voltage between terminals 10T and CH. 12 volts should be present. The speed relay should be energized.
    b. Check for voltage between terminals 14T and CH. 12 volts should be present. The heat relay should be energized.
12. Turn off the power to the thermostat module.
13. Place a jumper wire from the 8 terminal on thermostat module to the 7K terminal on the thermostat module.
14. Turn on the power to the thermostat module.

TG-V Module Bench Test (continued)

15. Set thermostat module setpoint to 33 F (0.6 C). The thermostat module should now be in low speed heat. (12 volts present on terminal 14T, zero volts present on terminal 10T). Leaving the jumper from the 8 terminal to the 7K terminal in place, set the thermostat module setpoint to 36 F (2.2 C).

16. Check voltage on 14T and 10T terminals.

    a. Check for voltage on terminal 14T. 12 volts should be present. The heat relay should be energized.

    b. Check for voltage on terminal 10T. Zero volts should be present. The speed relay should be de-energized. The thermostat module is in the eight minute high speed lockout mode of operation.

17. At the end of eight minutes, the thermostat module should automatically switch to high speed heat. Check the voltage at terminal 10T after the eight minute interval. 12 volts should be present.

18. Connect pin 86 of the third relay to the 11 terminal in order to simulate the defrost relay. Connect pin 85 of this relay to the positive (+) terminal of the power source.

19. Place a jumper between the 12 terminal and the negative (-) terminal of the power supply. Place another jumper between the 12 terminal and the 11 terminal. The relay should energize.

20. Remove the jumper between the 12 terminal and the 11 terminal. The relay should remain energized.

21. Remove the jumper between the 12 terminal and the negative (-) terminal of the power supply. The relay should de-energize.

TG-V Terminal Voltage Chart

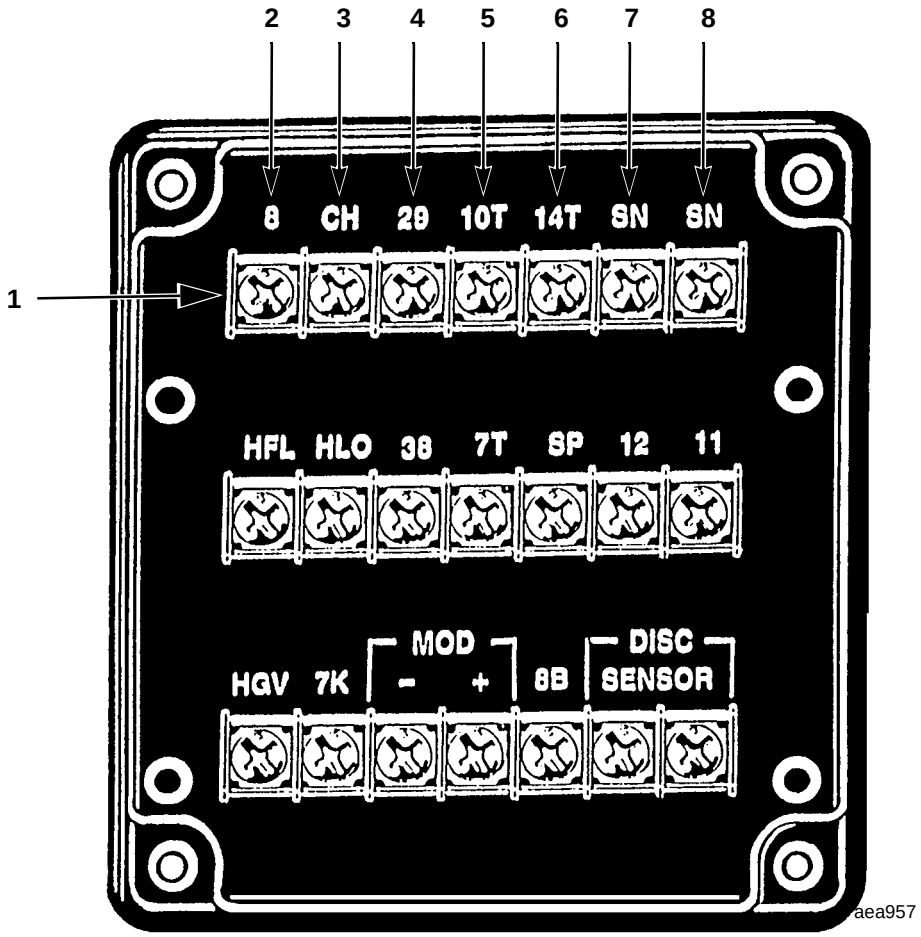
Voltages must be checked with the yellow jacketed sensor hooked across the SN terminals and the bulb placed in a 32 F (0 C) ice-water bath.

		HSC Setpoint 24°	LSC Setpoint 29°	LSH Setpoint 33°	HSH Setpoint 36°
	8	12 Vdc	12 Vdc	12 Vdc	12 Vdc
	CH	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	29	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	10T	12 Vdc	0 Vdc	0 Vdc	12 Vdc
	14T	0 Vdc	0 Vdc	12 Vdc	12 Vdc
Return Air Sensor	SN	—	—	—	—
	SN	—	—	—	—
	HFL	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	HLO	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	38	0 Vdc	12 Vdc	12 Vdc	0 Vdc
	7T	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	SP	1.95 Vdc	2.00 Vdc	2.04 Vdc	2.07 Vdc
	12	12 Vdc	12 Vdc	12 Vdc	12 Vdc
	11	12 Vdc	12 Vdc	12 Vdc	12 Vdc
	HGV	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	7K	0 Vdc	0 Vdc	0 Vdc	0 Vdc
MOD	(-)	0 Vdc*	0 Vdc*	0 Vdc*	0 Vdc*
	(+)	0 Vdc*	0 Vdc*	0 Vdc*	0 Vdc*
Disc	8B	0 Vdc	0 Vdc	0 Vdc	0 Vdc
	Sensor	—	—	—	—
	Sensor	—	—	—	—

← See note below.

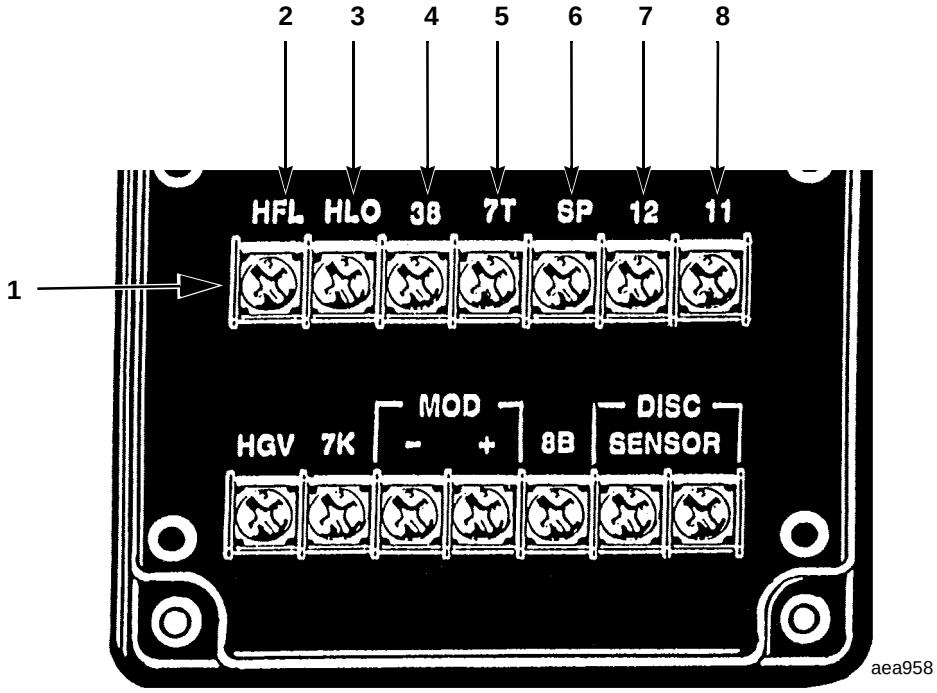
HSC - High Speed Cool
LSC - Low Speed Cool
LSH - Low Speed Heat
HSH - High Speed Heat

TG-V Terminal Identification



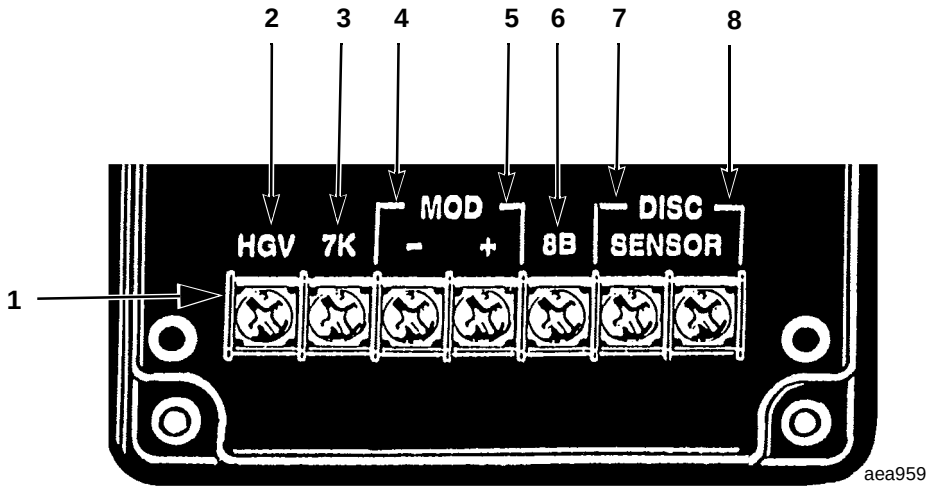
1.	Basic Terminal Functions
2.	(8) Supply Voltage From Unit To Thermostat Module
3.	(CH) Thermostat Module Ground Circuit
4.	(29) Force To High Speed (INPUT) During Defrost
5.	(10T) Applies Voltage To Speed Relay Coil When Calling For High Speed
6.	(14T) Applies Voltage To Heat Relay Coil When Calling For Heat
7.	(SN) Connects One Lead of the Return Air Sensor to Thermostat
8.	(SN) Connects Other Lead of the Return Air Sensor to Thermostat

TG-V Terminal Identification



1.	Specialized Terminal Functions
2.	(HFL) Force Heat Lockout
3.	(HLO) Heat Lockout Output
4.	(38) In-range Output
5.	(7T) Force High Speed Cool
6.	(SP) Setpoint Output
7.	(12) Defrost Circuit
8.	(11) Defrost Circuit

TG-V Terminal Identification



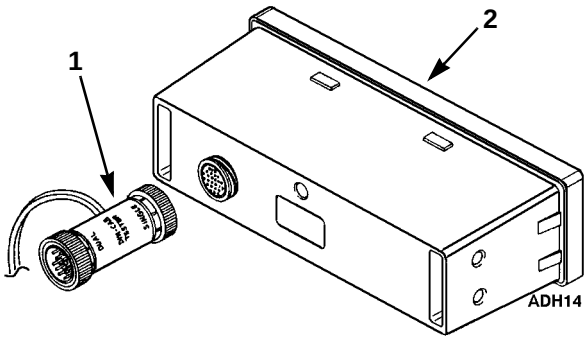
1.	Specialized Terminal Functions
2.	(HGV) Hot Gas Bypass Valve
3.	(7K) Accumulative Defrost Time and High Speed Delay Input
4.	(-) Output to Modulation Valve Not Connected to CH Ground
5.	(+) Output to Modulation Valve
6.	(8B) CYCLE-SENTRY is in Operation (INPUT)
7.	(DISC SENSOR) Connects One Lead of Discharge Air Sensor to Thermostat
8.	(DISC SENSOR) Connects Other Lead of Discharge Air Sensor to Thermostat

Field Test Procedure for Single Temperature In-Cab TG-V Controllers

Use tester P/N 204-831.

1. Connect the end of the tester marked “SINGLE” to the single temperature controller.
2. Power up the controller by connecting the tester leads to a 12 volt DC power supply.
3. Press the controller's ON key to display all segments.
   a. The TURTLE icon must be displayed. If not, press the TURTLE key. Alarm Code 19 will be recorded if the TURTLE icon is not displayed.
   b. If the ALARM icon is displayed, press the SELECT key to display the alarm and press the ENTER key to clear the alarm.
4. Press the SELECT key to display the setpoint and adjust the setpoint to 80 F.

   NOTE: The controller must be set to display temperatures in the Fahrenheit scale. The test will not work if the controller is displaying temperatures in the Celsius scale.
5. With the setpoint of 80 F displayed on the screen, press the following keys simultaneously:
   a. SELECT key.
   b. UP ARROW key.
   c. TURTLE key.
6. The display will read “FT”.
   a. All other icons will be off.
   b. The red, Power Cord LED will begin to flash on and off.
   c. All icons will then turn on for a few seconds.
   d. Then the display will count from 1 to 15.
   e. The display will then read PS for pass, or FC for fail.
   f. Press the OFF key to exit the test.

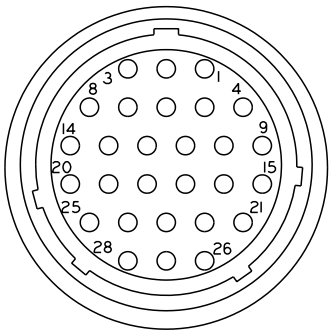


1.	Tester P/N 204-831 (Connect “Single” Side)
2.	In-cab TG-V Controller

Connect Tester to Controller

Connector Pins for Single Temperature In-Cab TG-V

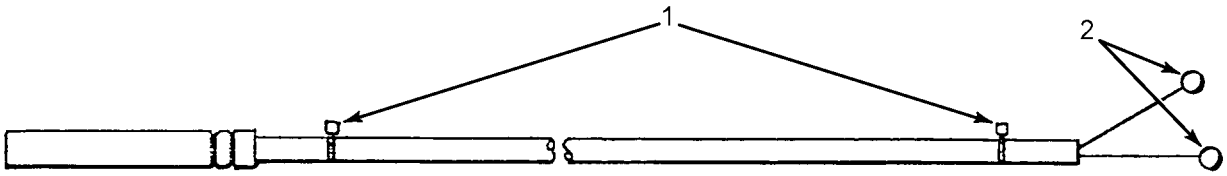
Pin #	Circuit Code	Harness Wire Color Code	Circuit Description
1		WHT/BLK/RED	
2	HGV	WHT/VOIL	Hot Gas Valve (Modulation Only)
3	8YY	WHT/ORG	On Relay (Power On)
4	MV-	BLUE	Modulation Valve Negative (Modulation Only)
5	CH	YELLOW	Battery Negative
6	8YY	WHT/BLK/ORG	On Relay (Power On)
7	WS	WHT/BLK/YEL	Whisper Relay
8	14T	WHT/RED	Heat Relay
9		WHT/BRN	
10	ACC		Accessory Wire to Truck Ignition
11	PC	WHT/BLK/VOIL	Power Cord (Electric Standby)
12	8B	WHT/BLK/BLU	CLCLE-SENTRY Input
13	10T	VIOLET	High Speed Relay
14	38	WHT/BLK/BRN	In-Range Output
15		WHT/GRN	
16	INDL	WHT/GREY	Alternator Output
17	8HB	WHT/BRN/RED	High Pressure Cutout
18	SN	WHITE	Return Air Sensor
19	SN	GREEN	Return Air Sensor
20	CH	WHT/BLK	Battery Negative
21	11	BRN	Defrost Relay Circuit
22	12	WHT/YEL	Defrost Termination Switch
23	7T	WHT/BLK/GRN	Not Used
24	DSN	BLK	Discharge Air Sensor
25	PS	WHT/BLU	On Relay Coil
26	7K	GREY	Latching Circuit after 8D
27	29	ORANGE	Defrost Damper Circuit
28	DSN	RED	Discharge Air Sensor



Connector on Back of Single Temperature In-Cab TG-V

Sensor Test

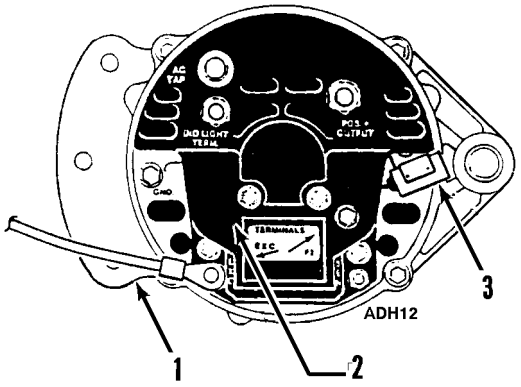
1. Visually check the bulb end, lead, and terminal end of the sensor. Make sure that it is not damaged.
2. Using an ohmmeter capable of reading at least 4000 ohms, check the resistance between the sensor lead terminals.
3. Sensor resistance should be approximately 3000 to 3500 ohms. Use the following method to give the sensor a more accurate test:
   a. Cool the sensor down to 32.0 F (0.0 C) and check the resistance. The reading should be 3266 ± 3.4 ohms.
   b. Warm the sensor up to 70.0 F (21.1 C) and check the resistance. The reading should be 3450 ± 6.9 ohms.
4. If the sensor does not meet specifications, replace it.



1.	Band Wraps—if used, the return air sensor has yellow band wraps and the discharge air sensor has red band wraps.
2.	Sensor Lead Terminals

Sensor

ALTERNATOR WITH INTEGRAL REGULATOR



1.	8D, 7K, 7KK, F1 or EXC Wire
2.	New Style Alternator (NO F1 Terminal)
3.	Filter Capacitor

NOTE: Alternators with integral regulators and alternators with remote regulators are not interchangeable on units equipped with CYCLE-SENTRY operation.

NOTE: Units manufactured with CYCLE-SENTRY and alternators with integral regulators MUST use replacement alternators with integral regulators.

CAUTION: "Full Fielding" alternators with the integral regulator is accomplished by installing a jumper from terminal F2 to ground. Attempting to full-field the alternator by applying battery voltage to terminal F2 will cause regulator failure.

CHARGING SYSTEM DIAGNOSTIC PROCEDURES

Complete the following checkout procedure before replacing the voltage regulator or the alternator:

1. With the unit switch OFF, attach a voltmeter to terminal SENSE and the alternator chassis. Voltmeter should indicate battery voltage.
2. With the unit switch ON, attach a voltmeter to terminal EXC and the alternator chassis. Voltmeter should indicate battery voltage.
3. To determine whether the alternator or regulator is faulty, attach a test lead between terminal F2 and chassis ground. Run the engine on high speed.

CAUTION: Never apply battery voltage to terminal F2.

a. Full alternator output indicates the alternator is good but the voltage regulator needs replacement.

b. If there is LOW or NO output, the alternator is probably faulty. However, the following items are potential causes for not charging:

- Check the alternator brushes.
- Check the 2A circuit from the alternator to the battery.
- Properly tension the alternator belt.
- Check the battery cable connections and the alternator ground. They must be clean and tight.
- The battery must be in good condition and must accept a charge.
- Check for excessive or unusual amperage draw by the unit control circuits.

NOTE: A loss of battery voltage to either terminal EXC or terminal SENSE will cause the alternator to stop charging.

12V ALTERNATORS WITH INTERNAL REGULATOR SETTING

When a Thermo King unit is installed on a truck, it is often connected to a truck battery. When both the Thermo King unit and the truck engine are running on the truck battery, the charging system with the higher voltage may automatically turn off the charging system with the lower voltage output.

Alternator Removal

1. Disconnect the battery power from the unit.
2. Remove the wires from the alternator terminals.
3. Remove the mounting bolts and remove the alternator.

Alternator Installation

1. Mount the alternator to the bracket, but do not tighten the bolts.
2. Install the alternator drive belt, tension properly and tighten the mounting bolts.
3. Install the wires and nuts on the alternator terminals and then tighten the nuts.
4. Connect the battery power to the unit.

BATTERY

Inspect/clean the battery terminals and check the electrolyte level during scheduled maintenance inspections. A dead or low battery can be the cause of the DC ALT LED indicating discharge due to lack of initial excitation of the alternator, even after the unit has been boosted for starting. The minimum specific gravity should be 12.35. Add distilled water as necessary to maintain the proper water level.

CHARGING SYSTEM

Immediately after start-up, the DC ALT LED may light to indicate a discharge condition on systems with brush type alternators. This is due to light film build-up on the alternator slip rings. The film build-up occurs primarily on units that have been sitting unused for long periods of time. The film should disappear after a minute or two, and the DC ALT LED should go out.

UNIT WIRING

Inspect the unit wiring and the wire harnesses during scheduled maintenance inspections for loose, chaffed or broken wires to protect against unit malfunctions due to open or short circuits.

GLOW PLUGS

Glow plugs heat the combustion chamber to aid in quick starting. The glow plugs are energized when the PREHEAT/START switch is held on the PREHEAT or the START position or when the CYCLE-SENTRY module initiates a unit start-up (CYCLE-SENTRY switch in the AUTO START/STOP position).

A defective glow plug (burned out) can be detected with the unit ammeter (optional). The unit ammeter should show 21 to 25 amps discharge while the PREHEAT/START switch is held in the PREHEAT position and the ON/OFF switch is in the OFF position. A discharge of 21 to 25 amps means all three glow plugs are working. If the discharge rate drops below 21 amps on PREHEAT, at least one glow plug is bad.

To isolate an open circuit glow plug, remove the bus bar and test each glow plug individually with an ohmmeter or a jumper wire and ammeter. Each glow plug should have a resistance of approximately 1.5 ohms or a current draw of about 8.3 amps.

A shorted glow plug will be indicated by the ammeter showing a very high current draw when the PREHEAT switch is pressed, the 50 amp circuit breaker tripping, or the fuse link burning out. Check each glow plug, a shorted glow plug will have very low resistance.

ENGINE RESET SWITCH

The engine is protected by a MANUAL RESET switch. The RESET switch is attached to a two sensors. One sensor switch is in the engine oil system, the other is in the engine cooling system.

If either sensor switch is grounded due to an abnormal condition (low oil pressure, or high water temperature), the RESET switch will trip and stop the engine in about 40 seconds.

The RESET switch must be replaced if it is defective.

Conditions that cause the RESET switch to trip:

1. Engine coolant (water) temperature over 220 F (104 C).
2. Engine oil pressure below 10 psig (69 kPa).
3. Lack of fuel to the engine. The LOW OIL PRESSURE switch will cause the RESET switch to trip after the engine stops.

   NOTE: If the ON/OFF switch(es) are in the ON position, if the CYCLE-SENTRY switch is in the CONT RUN position, and if the engine is not running; the LOW OIL PRESSURE switch will cause the RESET switch to trip.
4. High pressure in the refrigeration system. The LOW OIL PRESSURE switch will cause the RESET switch to trip after the high pressure cutout stops the engine.
5. RESET switch becomes defective. The switch may get to a point where it will open due to vibration.
6. A ground fault in the 20 or 20A wires to the sensor switches is also a possible cause.

   NOTE: A ground or shorter circuit in the electrical system does not cause the RESET switch to pop out.

HIGH WATER TEMPERATURE SWITCH (HWT)

The HWT will close and trip the RESET switch if the coolant temperature is greater than 220 F (104 C). Use a continuity tester to check the switch, and use a coolant temperature gauge to check the temperature.

1. Remove the 20A wire from the HWT.
2. Run the unit until it reaches normal operating temperature, approximately 180 F (82 C). There should be no continuity from the HWT to ground.
3. If the engine runs hot and the RESET switch does not trip, run the unit until it reaches 220 F (104 C). The HWT should have continuity to ground.

Replace the switch as necessary.

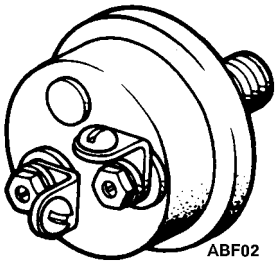
ENGINE LOW OIL PRESSURE SWITCH (LOP)

Engine oil pressure should rise immediately on starting, causing the OIL PRESSURE switch to open. If the oil pressure drops below 10 ± 3 psig (69 ± 21 kPa), the switch will close and trip the RESET switch and stop the engine. A continuity tester is needed to check the OIL PRESSURE switch.

1. Remove wire 20A from the switch.
2. Continuity tester should indicate a complete circuit between the terminal and ground.
3. Start the engine. Tester should show an open circuit between the terminal and ground.

ENGINE LOW OIL PRESSURE SWITCH (continued)

Repair consists of replacing the switch.



Engine Low Oil Pressure Switch

CIRCUIT BREAKERS

Main Circuit Breaker

This 50 amp auto reset circuit breaker protects 2A, the main power circuit.

If the circuit breaker opens:

1. Check for a short in one of the glow plugs.
2. Check for a ground in the 2A or H circuits.

Control Circuit Breaker

This 20 amp auto reset circuit breaker protects the unit control circuits.

If the circuit breaker opens, check the unit for a grounded wire or a grounded condition in a relay or solenoid.

Evaporator Fan Circuit Breaker

This 25 amp auto reset circuit breaker protects the evaporator fan circuits.

If the circuit breaker opens, check the evaporator fans, and the 2C and EF circuits.

FUSE LINK

The fuse link protects the electrical system if a circuit breaker fails to open. If the fuse link burns out, check for a grounded 2 wire or for any of the conditions that would cause one of the circuit breakers to open. Replace the defective circuit breaker and replace the fuse link.

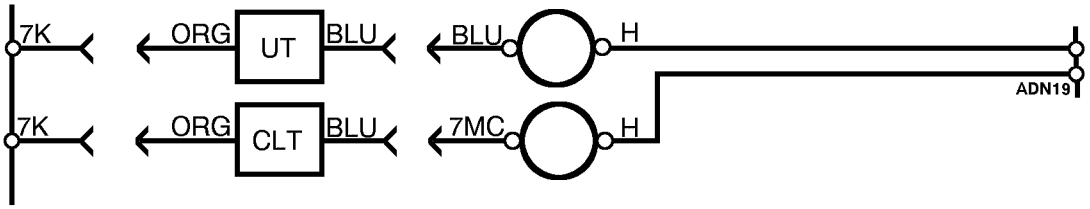
UNLOADING TIMERS (UT)

The unloading timer (UT) energizes the unloading relay (UR) for approximately 40 seconds when the engine is first started to reduce the load on the engine. The unloading relay opens the 7K-7KC circuit, which supplies power to the EXC terminal on the alternator.

This de-energizes the field coil, which keeps the alternator from charging and allows the alternator to turn freely. The unloading relay also opens the INDL-FR circuit, which de-energizes the fan relay (FR). This de-energizes the fan motors to reduce the current draw on the battery while the alternator is not charging. If the UT is defective, it may be difficult to start the engine.

Testing the Unloading Timer

1. Place an ON/OFF switch in the OFF position, place the CYCLE-SENTRY switch in the CONT RUN position, and place the DIESEL/ELECTRIC switch in the DIESEL position.
2. Disconnect the unloading timer wires (BLU and ORG) from the main wire harness (BLU and 7K) at the two pin connector.
3. Check the resistance between the BLU wire in the main wire harness and ground. If the resistance is more than 100 ohms, check the BLU wire to the unloading relay, the unloading relay coil, the H circuit, and the glow plugs for bad connections or opens.



Partial Schematic

4. Hold the PREHEAT/START switch in the PREHEAT position and check for battery voltage at the BLU wire in the main wire harness. If battery voltage is not present or if it is low, check the H circuit, the PREHEAT/START switch, and the 2A circuit for bad connections or opens.
5. Place the ON/OFF switch(es) in the ON position and check for battery voltage at the 7K wire in the main wire harness. If battery voltage is not present or if it is low, check the 7K circuit and the other circuits and components back to the battery for bad connections or opens.
6. Place the ON/OFF switch in the OFF position.
7. Connect the unloading timer wires to the main wire harness at the two pin connector. Attach one lead of a voltmeter to the ORG wire and attach the other lead to the BLU wire.
8. Place the ON/OFF switch in the ON position and check the voltage between the ORG and BLU wires. No voltage or very low voltage should be present when the ON/OFF switch is first turned on. Approximately 40 seconds after the ON/OFF switch is turned ON, battery voltage should appear between the ORG and BLU wires. If battery voltage is present when the ON/OFF switch is first turned ON, or if battery voltage does not appear approximately 40 seconds after the ON/OFF switch is turned ON, the unloading timer is defective and must be replaced.

CLUTCH TIMER (CLT)

The clutch timer (CLT) keeps the clutch relay (CLR) from energizing for 20 sec when the engine is first started to reduce the load on the engine. The clutch is timed to be staged in 20 seconds earlier than the evaporator fans. The clutch relay is energized by 7K-7MC through the clutch timer. The clutch relay pulls in and supplies power to the compressor clutch through the (CLR) from 2C to CLU.

Testing the Clutch Timer (CLT)

1. Place the ON/OFF switch in the OFF position, place the CYCLE-SENTRY switch in the CONT RUN position, and place the DIESEL/ELECTRIC switch in DIESEL position.
2. Disconnect the clutch timer wires (BLU and ORG) from the main wire harness (7MC and 7K) at the two pin connector.
3. Check the resistance between the BLU wire in the main wire harness and ground. If the resistance is more than 100 ohms, check the 7MC wire to the clutch relay, the clutch relay coil, the H circuit and the glow plugs for bad connections for opens.
4. Hold the PREHEAT/START switch in the PREHEAT position and check for battery voltage at the 7MC wire in the main wire harness. If battery voltage is not present or if it is low, check the H circuit, PREHEAT/START switch and the 2A circuit for bad connections or opens.

Testing the Clutch Timer (continued)

5. Place the ON/OFF switch(es) in the ON position and check for battery voltage at the 7K wire in the main harness. If battery voltage is not present or if it is low, check the 7K circuit and the other circuits and components back to the battery for bad connections or opens.
6. Place an ON/OFF switch in the OFF position.
7. Connect the clutch timer wires to the main wire harness at the two pin connector. Attach one lead of a voltmeter to the ORG wire and attach the other lead to the 7MC wire.
8. Place the ON/OFF switch in the ON position and check the voltage between the ORG and BLU wires. No voltage or very low voltage should be present when the ON/OFF switch is first turned ON. Approximately 20 seconds after the ON/OFF switch is turned ON, battery voltage should appear between the ORG and BLU wires. If battery voltage is present when the ON/OFF switch is first turned ON, or if battery voltage does not appear approximately 20 seconds after the ON/OFF switch is turned ON, the clutch timer is defective and must be replaced.

DEFROST SYSTEM

CAUTION: CYCLE-SENTRY Equipped Units—Place the CYCLE-SENTRY switch in the CONT RUN position before performing any diagnosis and service operations on the unit. The unit may start at any time without prior warning if the ON/OFF switch is in the ON position and the CYCLE-SENTRY switch is in the AUTO START/STOP position.

The unit should be run through a defrost cycle during After Start Inspections and during scheduled maintenance inspections to test defrost system components. To check the defrost cycle, run the unit on cool and set the thermostat to drop the evaporator coil temperature below 42 F (5.6 C). Press the MANUAL DEFROST switch. The unit should shift from the cool cycle to the defrost cycle.

If the unit continues to cool, double check the evaporator coil temperature and refer to the Defrost Cycle Checkout Procedure.

The AIR switch setting should be checked annually. Refer to the Air Switch Testing and Adjustment.

Defrost Cycle Diesel Operation

The Defrost cycle can be initiated with the MANUAL DEFROST switch, by the AIR switch, or by the defrost timer in the TG-V when the DEFROST TERMINATION switch is closed.

The initiation of the Defrost cycle energizes the defrost relay, which energizes the 26 circuit, the DEFROST light, and the low speed defrost relay, and de-energizes the fan relay.

The 26 circuit energizes the LLS and the HGS. This diverts heated refrigerant vapor to the evaporator coil, melting any accumulated frost. The evaporator fans are de-energized to hold the heat within the evaporator and prevent warm air from passing over the load. The throttle solenoid is de-energized so the unit runs in low speed.

NOTE: The unit will not defrost during normal unit operation unless the Defrost cycle is initiated while the evaporator temperature is below 42 F (5.6 C).

The DEFROST TERMINATION switch will open and de-energize the defrost relay when the frost has melted and the evaporator temperature rises above 52 F (11.1 C). The thermostat then determines the unit's mode of operation.

Defrost Cycle Electric Operation (Model 50 Units)

The Defrost cycle on electric standby operation is similar to defrost on diesel operation. An optional heat contactor, HIGH TEMPERATURE CUTOUT switch, and electric heater strips can be added for increased defrosting capability. The Model 50 EEC uses an ELECTRONIC HIGH TEMPERATURE switch instead of the HIGH TEMPERATURE CUTOUT switch.

The electric heater strips are energized by the heater contactor and the 26 circuit. The HIGH TEMPERATURE CUTOUT switch or ELECTRONIC HIGH TEMPERATURE switch must be closed to energize the heater contactor. The heater strips are also energized when the unit is in heat.

Defrost Cycle Checkout Procedure

CAUTION: CYCLE-SENTRY Equipped Units—Place the CYCLE-SENTRY switch in the CONT RUN position before performing any diagnosis and service operations on the unit. The unit may start at any time without prior warning if the ON/OFF switch is in the ON position and the CYCLE-SENTRY switch is in the AUTO START/STOP position.

To check the Defrost cycle, run the unit on cool until the evaporator coil temperature is below 42 F (5.6 C). Push the MANUAL DEFROST switch.

If the unit shifts to defrost momentarily but shifts out of defrost when the switch is released, check the TG-V thermostat, and the 11 and 12 wires to the TG-V.

If the unit will not shift to defrost, or if the Defrost cycle will not terminate, see the following defrost checkout procedures.

CAUTION: Do not forget to remove the jumper wires from the unit after checking or testing unit components.

Unit Does Not Defrost

1. Check the evaporator temperature:

   Make sure the evaporator temperature is actually below 42 F (5.6 C) if the unit will not defrost. Use a test thermometer to check the evaporator temperature.

2. Check the operation of the DEFROST TERMINATION switch:

   If the unit fails to defrost, place a jumper wire between the 12 terminal and the CH terminal on the switch panel board. Press the MANUAL DEFROST switch. If the unit shifts to defrost, check the 12 wire to the DEFROST TERMINATION switch for an open and check for a defective DEFROST TERMINATION switch.

   If the unit still fails to defrost, move to step 3.

3. Check the MANUAL DEFROST switch:

   If the unit failed to defrost, place a jumper wire between the 11 terminal and the CH terminal on the switch panel board. If the unit shifts to defrost immediately, replace the MANUAL DEFROST switch.

   If the unit does not shift to defrost, move to step 4.

4. Check the 11 circuit:

   If the unit failed to defrost, check for an open in 11 circuit between the switch panel board and the relay board. If the 11 circuit is intact, move to step 5.

5. Check the defrost relay:

   If the unit fails to defrost, check the 8 circuit at the defrost relay socket for 12 volts. If the 8 circuit has 12 volts, the defrost relay is defective and should be replaced. A lack of voltage indicates an open in the 8 circuit.

6. If the defrost relay works, the DEFROST INDICATOR light comes on and the fans stop, but the unit continues to cool; check the 26 circuit, the LLS, and the HGS.

Defrost Cycle Checkout Procedure (continued)

Unit Will Not Terminate Defrost

If the DEFROST TERMINATION switch does not open and terminate defrost less than 45 minutes after defrost was initiated, the TG-V should terminate defrost in 45 minutes. If the unit stays in defrost longer than 45 minutes, code 14 will generate.

Unit Sticks In Defrost Indefinitely

If the unit remains stuck in defrost indefinitely, check the defrost relay, the 11 and 11A circuits and the TG-V thermostat.

1. Unplug the defrost relay and check the 11 and 11A circuits:

   Unplug the defrost relay and check the A slot in the defrost relay socket for continuity to CH (ground). If there is no continuity from the A slot to CH (ground), replace the defrost relay. If there is continuity from the A slot to CH (ground), check the 11 and 11A circuits for a short to ground. If no short is found, move to step 2.

2. Check the TG-V thermostat:

   The integral defrost timer in the TG-V thermostat should terminate the defrost cycle after 45 minutes regardless of the evaporator temperature or amount of frost or ice on the evaporator coil. If not, test the TG-V and replace it if necessary.

Unit Continually Fails to Terminate Defrost In Less than 45 Minutes

If the unit continually fails to complete the Defrost cycle in less than 45 minutes and cycles between cool and defrost, check the evaporator coil temperature, LLS, HGS, refrigerant charge, fan relay, DEFROST TERMINATION switch, and the 12 circuit.

1. Check the evaporator temperature:

   Be sure the evaporator temperature is actually above 52 F (11.1 C) if the unit will not terminate defrost. Use a test thermometer to check the temperature. If the evaporator temperature does not rise enough to bring the unit out of defrost, the LLS or the HGS may be faulty, or the unit may be low on refrigerant.

   To check the refrigerant charge, refer to Refrigerant Charge in the Refrigeration Maintenance Section.

2. Check the operation of the DEFROST TERMINATION switch.

   If the unit will not come out of Defrost, disconnect the 12 wire from the DEFROST TERMINATION switch. If the unit shifts back to cool, the DEFROST TERMINATION switch is not opening and should be replaced. If the unit remains in defrost, move to step 3.

3. Check the and 12 circuit for a ground:

   If the unit remains in defrost, use an ohmmeter to check the 12 wire for a ground. If a 12 wire is grounded, find the grounded portion and repair it.

Defrost System Components

MANUAL DEFROST Switch

The MANUAL DEFROST switch is located on the unit switch panel board. Pressing the MANUAL DEFROST switch initiates the Defrost cycle if the DEFROST TERMINATION switch is closed.

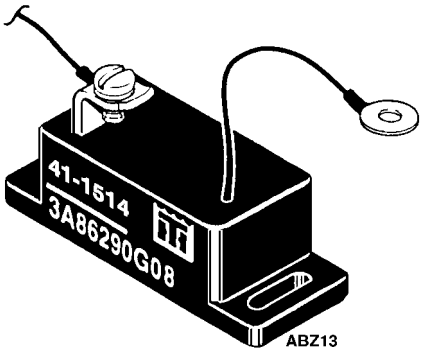
DEFROST TERMINATION Switch

The electronic DEFROST TERMINATION switch uses solid state components to control the Defrost cycle. The switch is mounted in the evaporator and controls the Defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 42 F (5.6 C), completing the defrost circuit to ground and preparing the electrical system for the Defrost cycle.

When the unit does shift into a Defrost cycle, the fans stop, and heat from the hot refrigerant gas melts the frost from the evaporator coil. The switch opens and terminates the Defrost cycle when the evaporator coil temperature rises to 52 F (11.1 C).

Installation

The proper polarity must be observed when installing the DEFROST TERMINATION switch. The wire from the defrost thermostat is negative and must be attached to the chassis ground of the unit. This chassis ground wire must be grounded on a screw separate from the switch mounting screws or an improper ground may result. The 12 wire from the unit attaches to the terminal mounted solid on the switch. If the polarity is reversed on the device, it will conduct continuously and act like a switch that is stuck closed.



DEFROST TERMINATION Switch

DEFROST TERMINATION Switch Bench Test

1. Connect a test light between the screw terminal on the switch and the positive battery terminal.

   NOTE: Attempting to test the electronic DEFROST TERMINATION switch with an ohmmeter is generally not satisfactory because of the low voltage available at the meter leads.

2. Connect the negative lead of the switch to the negative battery terminal.

3. Raise the temperature of the DEFROST TERMINATION switch above 52 F (11.1 C). The light should be off indicating an open switch.

4. Cool the DEFROST TERMINATION switch below 42 F (5.6 C). The light should come on indicating the switch has closed.

   NOTE: Allow adequate time for the temperature change to saturate the switch before performing the test.

Defrost Relay

The defrost relay controls the operation of the unit on the defrost cycle. When the AIR switch, the TG-V defrost timer, or the MANUAL DEFROST switch complete the circuit through the DEFROST TERMINATION switch to ground, the defrost relay pulls in to initiate defrost and energize the DEFROST light. A holding circuit in the TG-V keeps the unit on defrost until the DEFROST TERMINATION switch opens.

AIR Switch

The AIR switch automatically places the unit on defrost when ice accumulation on the evaporator coil builds up to a point where the air flow across the coil is restricted.

Restricted air flow results in a pressure difference between the evaporator coil inlet and outlet. The AIR switch senses the pressure differential across the coil and initiates the Defrost cycle.

The AIR switch is preset at the factory. Normally readjustment is not necessary unless the switch has been tampered with or does not function properly due to factors affecting air circulation, such as bulkhead construction and duct work

AIR Switch Testing and Adjustment

Before testing or adjusting the AIR switch, check the clear plastic tubing and black plastic tubing to the evaporator coil. Make sure they are not obstructed or crushed. Check the probes in the evaporator housing to be sure they are not obstructed.

1. Remove plastic sensing tubing from both sides of the AIR switch.
2. Disconnect one wire at the switch terminal. Connect a test light or continuity tester to the two terminals used on the switch.
3. Connect the test equipment (P/N 204-442 and P/N 204-494) to the hose fitting on the side of the AIR switch stamped BLACK.
4. Pressurize the hose until the continuity tester indicates a completed circuit. Now read the dial of the test gauge. This is the setpoint of the AIR switch (correct reading is 0.50 ± 0.05 in. [12.7 ± 1.3 mm] H_2O). Release the pressure.
5. If the switch is out of calibration, pressurize the hose again until the tester indicates 0.50 in. (12.7 mm) H_2O. Turn the adjustment screw until the switch closes and the continuity tester indicates a completed circuit with the gauge reading of 0.50 in. (12.7 mm) H_2O. Release the pressure.
6. Repeat the test procedure several times to be sure the setting is correct.
7. Remove the test equipment. Connect the wire and air sensing tubes to the switch. The BLACK hose from the high pressure or air inlet side of the evaporator coil goes on the hose fitting on the side of the AIR switch stamped BLACK. The CLEAR hose from the low pressure or air outlet side of the evaporator coil goes on the hose fitting on the side of the AIR switch stamped CLEAR.

NOTE: Route hoses for continuous slope to avoid condensate traps.

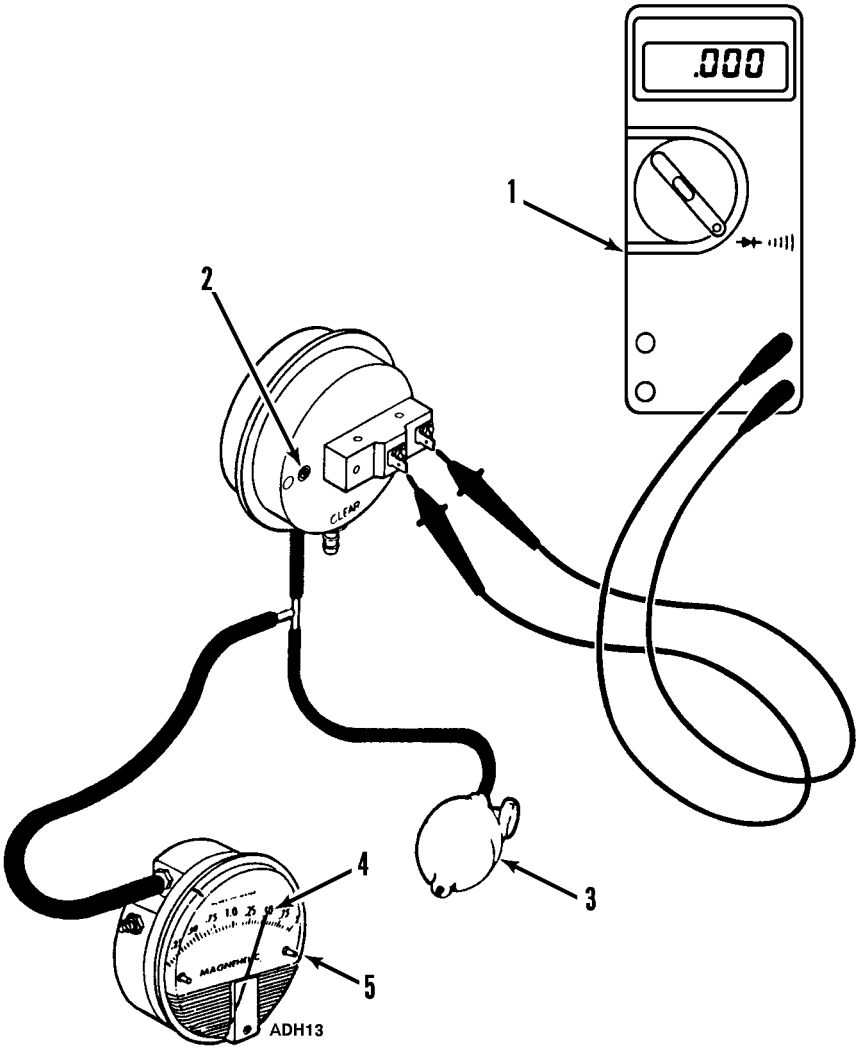
If too much frost continues to accumulate before defrost is initiated, decrease the pressure setting. Turn the adjustment screw counterclockwise.

If defrost occurs with too little frost accumulation, increase the pressure setting. Turn the adjustment screw clockwise.

Measuring Evaporator Coil Pressure Differential

If the AIR switch is initiating defrost too often even though the AIR switch is adjusted properly, the tubing is routed correctly, and the probes are positioned correctly, the air flow through the evaporator may be restricted.

1. Run the unit through a Defrost cycle to clear the evaporator coil of frost.
2. Remove the plastic sensing tubes from the AIR switch.
3. Connect a Magnehelic pressure gauge (P/N 204-442) to the plastic sensing tubes.



1.	Continuity Tester
2.	Adjustment Screw
3.	Squeeze Bulb (P/N 204-494)
4.	Pressure in Inches of Water (P/N 204-442)

Air Switch Testing and Adjustment

4. Run the unit in high speed cool and measure the evaporator coil pressure differential. If the pressure differential of the clear coil is more than one half of the AIR switch setpoint, the evaporator coil is restricted and must be cleaned.

5. Remove the test equipment. Connect the air sensing tubes to the switch. The BLACK hose from the high pressure or air inlet side of the evaporator coil goes on the hose fitting on the side of the AIR switch stamped BLACK. The CLEAR hose from the low pressure or air outlet side of the evaporator coil goes on the hose fitting on the side of the AIR switch stamped CLEAR.

CHARGING SYSTEM (12 VDC)

Immediately after start-up, the LED or ammeter (optional) may show a discharge condition on systems with brush type alternators. This is due to a light film build-up on the alternator slip rings. The film build-up occurs primarily on units that have been sitting unused for long periods of time. The film should disappear after a minute or two, and the LED or ammeter (optional) should show a high charge rate that will continue until the battery voltage is brought back up to normal. Under normal running conditions, the ammeter will show a slight charge condition. If the ammeter shows a discharge after start-up, check the alternator belt tension and all charging circuit connections including the battery.

NOTE: On installations where the CD-II MAX unit is connected to the truck battery and both units are running—it is normal for the unit charge LED or optional ammeter to indicate a discharge condition while the truck engine is running because of the truck's higher voltage charge rate.

CD-II MAX Units Equipped with a Three-Phase Electric Motor and a Phase Converter That Operates on Single-Phase Power

The CD-II MAX Model 50 units that are ordered with the single-phase 220 volt electric standby option are equipped with a three-phase electric motor and a phase conversion system. This electric motor is the same 5/4.2 hp (3.7/3.1 kW) motor used in units with a three-phase electric standby option. The phase conversion system enables the three-phase electric motor to operate using power from a single-phase power source.

NOTE: The suction pressure regulator must be set at a maximum of 25 psig (172 kPa) on these single-phase units. A higher setting will overload the electric motor. To check the suction pressure regulator setting, run the unit on defrost and observe the suction pressure.

The overload relay is set at 18 amps. A higher setting may not provide adequate protection.

Voltage taps (230 volt or 208 volt) for the transformer are located on the test strip in the control panel. To make sure the unit operates properly, wire L1A should be connected to the voltage tap that matches the voltage of the power source. Wire L1A is normally connected to the 208 volt tap.

CONVERSION SYSTEM

The phase conversion system itself consists of a start system and a run system. The start system is energized by the high current draw that is present while the motor is starting under a load. Once the motor is running at normal speed and the current draw has dropped, the start system is de-energized and the run system is solely responsible for the phase shift. The run system is always connected to the motor circuit, but it does not affect the circuit while the start system is energized because the start capacitors have much larger capacitance and dominate the run capacitors.

Start System

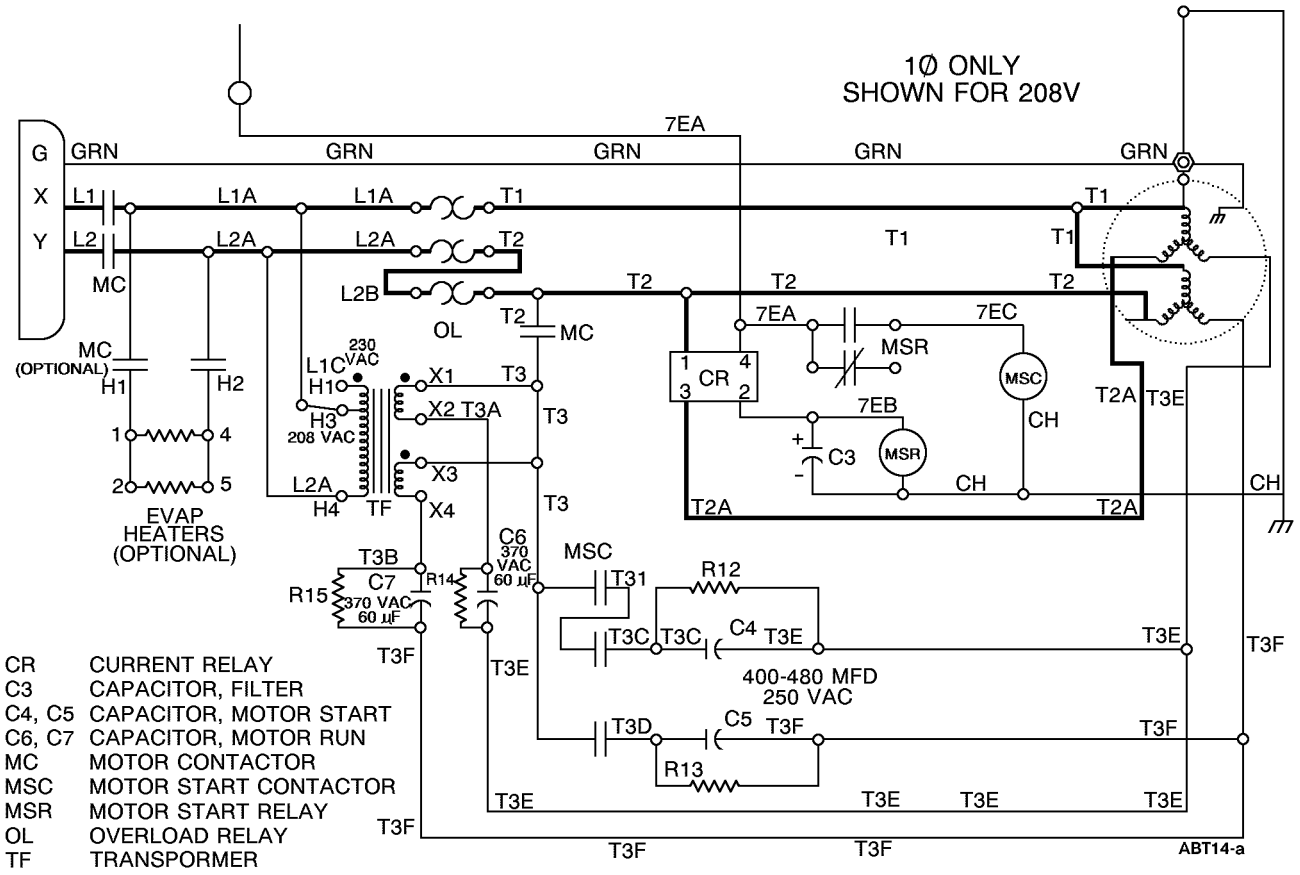
The components of the start system are:

- a current relay
- a motor start relay

- a motor start contactor
- a filter capacitor
- two start capacitors (400 to 480 µF each)
- two start bleed down resistors (180 k ohms each)

Single-phase power is available at L1 and L2. L1 and L2 pass through the motor contactor and become L1A and L2A. L1A passes through the overload relay to become T1. L2A passes through the overload relay to become L2B. L2B passes through the overload relay to become T2.

The three-phase motor has two separate sets of windings with three windings in each set. Branches of T1 are connected directly to the first winding in each set. A branch of T2 is connected directly to the second winding in one set. Another branch of T2 passes through the control coil of the current relay and becomes T2A, which is connected to the second winding in the other set.

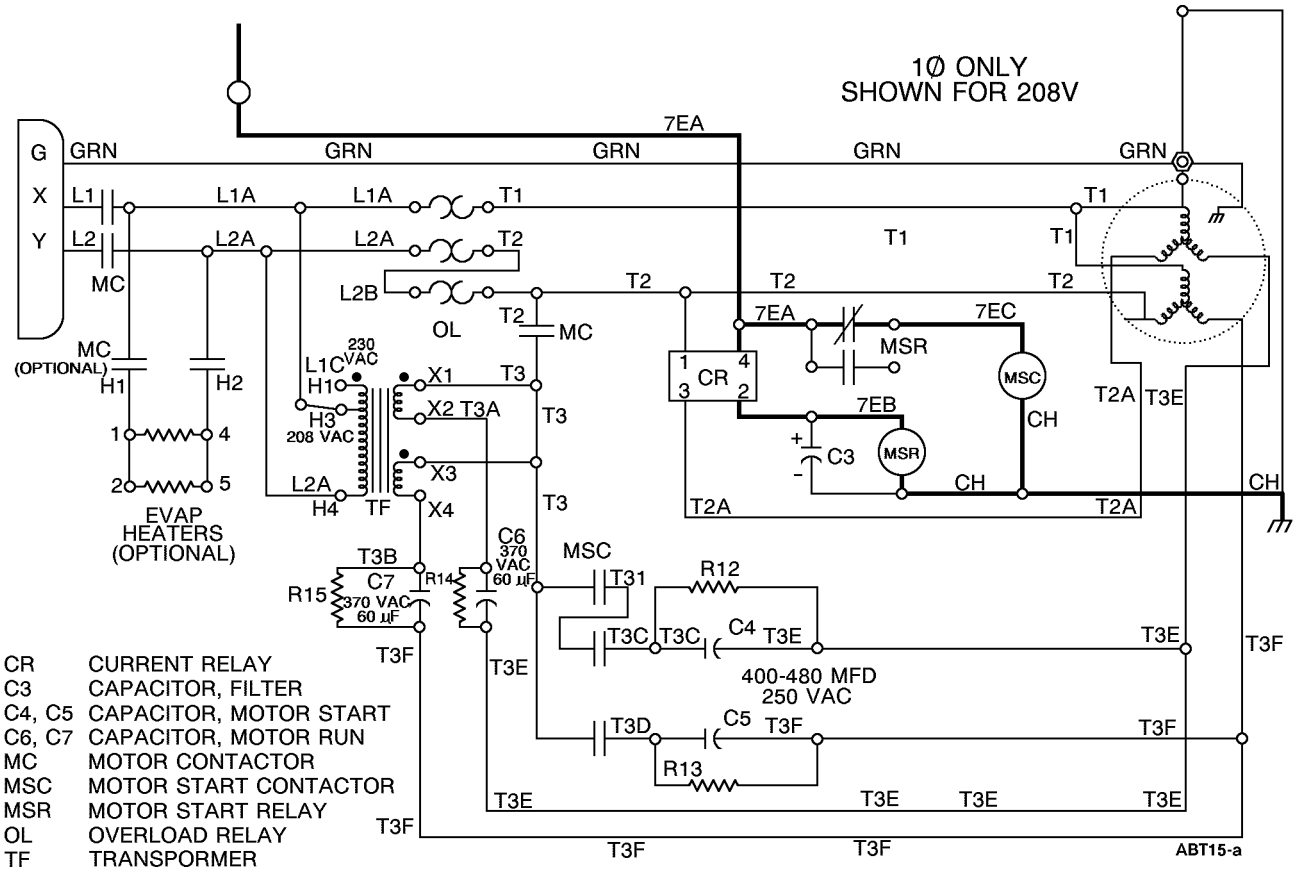


First and Second-Phase Connections

L1 and L2 supply power directly to the first and second windings in both sets of windings in the motor

A branch of T2 passes through the motor contactor to become T3. A branch of T3 passes through the motor start contactor and a start capacitor to become T3E, which is connected to the third winding in one set. Another branch of T3 passes through the motor start contactor and a start capacitor to become T3F, which is connected to the third winding in the other set.

When the motor is starting under a load, the current in T1 and T2 climbs to a fairly high rate. When the current in T2-T2A passes through the control coil of the current relay exceeds 27 amps, the current relay is energized and its contacts close.



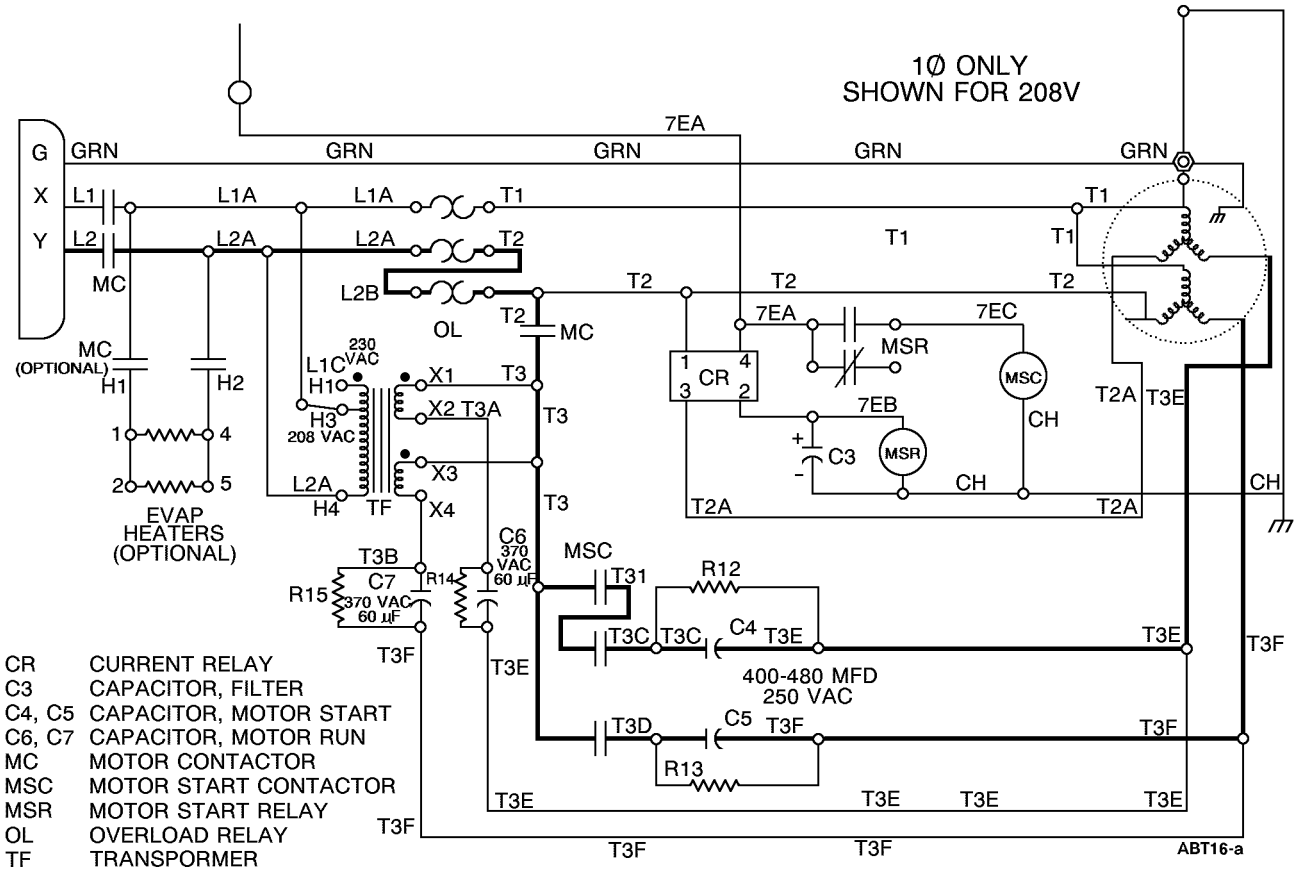
Motor Start Contactor Control Coil Circuit

7EA energizes the motor start contactor through the start relay when the current in T2-T2A exceeds 27 amps

Wire 7EA supplies control voltage from the unit to the current relay at terminal 4. When the current relay is energized, control voltage passes through the contacts to terminal 2 and wire 7EB to energize the motor start relay. The C3 capacitor, which is connected in parallel with the control coil of the motor start relay, works with the motor start relay to act as a smoothing device to reduce chatter in the motor start contactor.

A branch of wire 7EA also supplies control voltage to one side of the motor start relay contacts. When the motor start relay is energized, control voltage passes through the closed contacts and wire 7EB to energize the motor start contactor.

The contacts in the motor start contactor close when it is energized through the motor start relay. T3E and T3F are energized and the start capacitors provide the phase shift and boost in power necessary to start the motor under a load.



Third Phase Connection During a Start

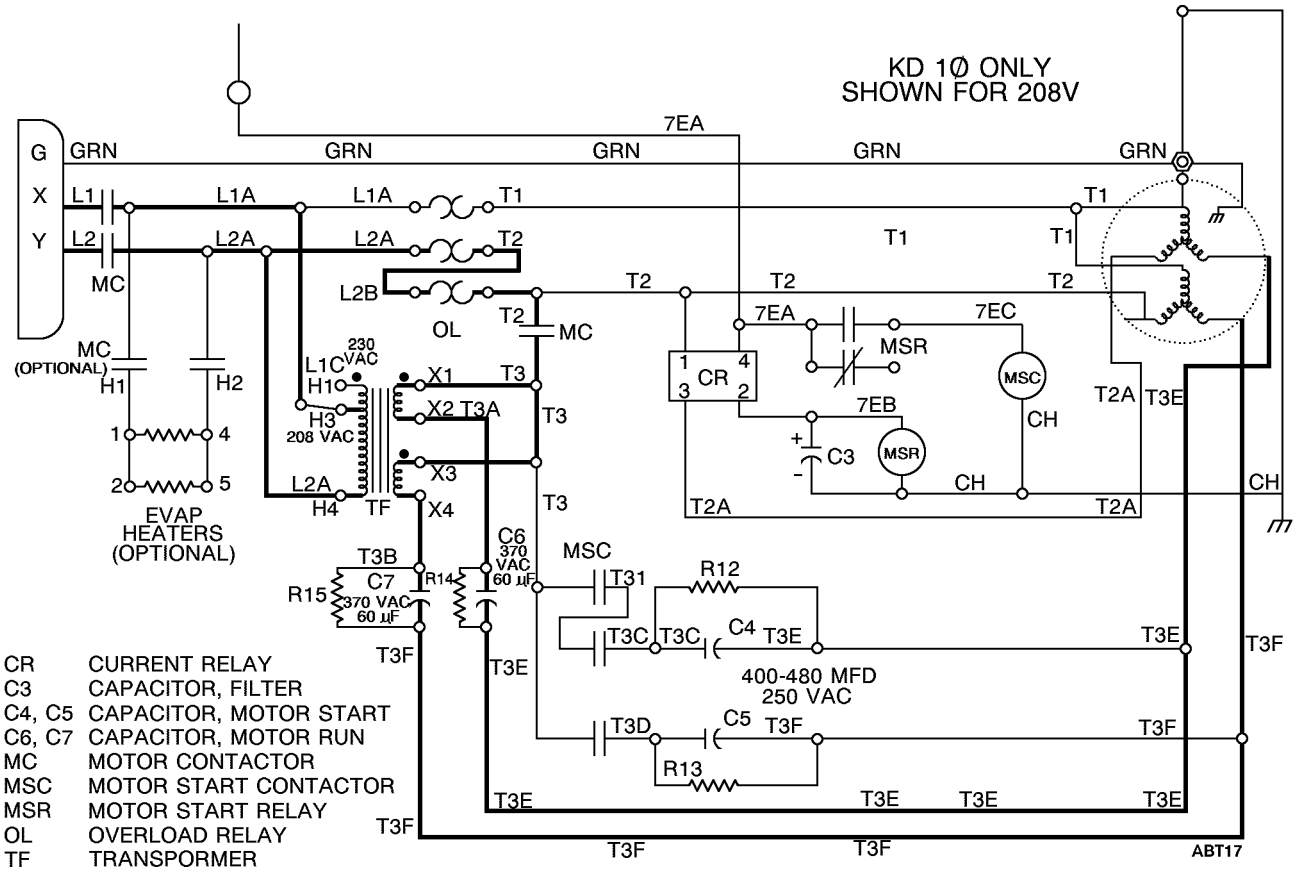
L2 supplies power to the third windings in both sets of motor windings through the start second windings in both sets of windings in the motor

As the motor approaches normal running speed, the current through T2-T2A drops. When this current drops below 22 amps, the current relay is de-energized. This de-energizes the motor start relay, the motor start contactor and the start capacitors. The start system is now disconnected from the motor circuit and the run system provides the phase shift necessary to operate the motor at normal running speed.

Run System

The components of the run system are:

- a run transformer
- two run capacitors (60 µF each)
- two run bleed down resistors (560 k ohms each)



Third Phase Connection While Running Normally

L1 and L2 supplies power to the third windings in both sets of motor windings through the run transformer and the run capacitors

The primary winding of the run transformer is connected to L1A on one side and to L2A on the other side. A branch of T3 passes through one of the secondary windings on the run transformer and one of the run capacitors to become T3E, which is connected to the third winding in one set of the motor windings. Another branch of T3 passes through the other secondary winding of the run transformer and the run capacitor to become T3F, which is connected to the third winding in the other set of motor windings. The run transformer and the run capacitors combine to provide a phase shift and power needed to operate the motor at its normal running speed.

The run transformer, run capacitors, and start capacitors are located in a control box under the motor pedestal. These components can be accessed by removing the motor and pedestal assembly from the unit's condenser frame. The wiring harness connected to the motor is long enough to allow the motor and pedestal assembly to be set beside the unit and test run if necessary.

The current relay, motor start relay, motor start contactor, and a test point strip are located in the unit's main control box. The test point strip is used to diagnose problems associated with the run transformer, the run capacitors, and the start capacitors.

Troubleshooting the Phase Conversion System

If the electric motor does not run properly, first check the line voltage, the motor contactor, and the motor overload relay. If these are all acceptable, test the electric motor to narrow down the possible causes for the problem. See the Troubleshooting Chart for the individual component tests.

Electric Motor Tests

Test 1. Run the motor with three-phase power.

Disconnect the T1, T2, T2A, T3E, and T3F wires from the motor and connect three-phase power directly to the motor. Connect L1 to leads 1 and 7, connect L2 to leads 2 and 8, and connect L3 to leads 3 and 9. Start and run the unit. Check and record the voltage and current readings in a copy of the following chart.

Wires	Voltage	Wire	Start Current	Run Current
L1-L2	_____	L1	_____	_____
L2-L3	_____	L2	_____	_____
L3-L1	_____	L3	_____	_____

The ideal voltage is 208 to 235 volts AC and the voltage should not vary more than 10% between the sets of wires. If the voltages are out of these ranges, check the power source.

The start current should be approximately 75 amps.

The run current should not exceed 14.5 amps.

The current should not vary more than 10% between wires.

If the run current is higher than 14.5 amps in all three wires, check the suction pressure regulator setting before replacing the motor. Check the setting of the suction pressure regulator by observing the suction pressure while the unit is running in defrost. If the suction pressure is higher than 25 psig (172 kPa), the suction pressure regulator must be adjusted or replaced.

Replace the motor if currents are out of these ranges.

Test 2. Run the motor with single-phase power and the phase conversion system connected to the motor.

Remove the electrical connection box cover on the motor, and check and record the current readings in a copy of the following chart.

Wire	(Motor Lead)	Start Current	Run Current
T1	(1)	_____	_____
T1	(7)	_____	_____
T2	(3)	_____	_____
T2A	(9)	_____	_____
T3E	(2)	_____	_____
T3F	(8)	_____	_____

The electric motor has two sets of windings. This test separates the sets.

The start current should begin at 40 to 45 amps, and then drop off to approximately 20 amps in 1 to 3 seconds (in wires T2 and T2A). After 3 seconds, the run current should stabilize at 4 to 8 amps (in each of the six wires).

Circuit T2A contains the current relay, which controls the motor start contactor. If the start current is in the proper range but the motor does not shift to run after 3 seconds, go to Test 3. If the start or run currents are very uneven, go to the start or run capacitor checks in the Troubleshooting Chart.

NOTE: Wire L1A should be connected to the transformer voltage tap that matches the line voltage of the power source. High voltage on the 208 volt tap will cause high run currents.

Test 3. The unit starts but does not shift to the run system.

If the motor starts correctly but the current remains at approximately 20 amps after 3 seconds, the start system is not being de-energized. Use the following procedure.

1. Locate the current relay in the main control panel.
2. Disconnect the 7EA and 7EB wires.

3. Install a switch between the 7EA and 7EB wires.
4. Close the switch between the 7EA and 7EB wires and start the motor.
5. Wait 3 seconds and then open the switch between the 7EA and 7EB wires.
    a. If the motor does not shift to run, check for a faulty motor start relay or a faulty motor start contactor.
    b. If the motor shifts to run, check for a faulty current relay or an overload on the motor.
    c. If the motor shifts to run but then slows down or stops, check for a faulty transformer or faulty run capacitors.

See the Troubleshooting Chart for the individual component tests.

TROUBLESHOOTING CHART

NOTE: All amperage and voltage measurements should be taken with the unit turned ON and the motor running or attempting to start. Most of the voltage measurements can be taken inside the unit control box, from the components in the high voltage tray and from the test point strip. The voltage measurements associated with the components under the motor pedestal should be taken at the test point strip before checking the components and connections under the pedestal. The overload relay will trip if the motor does not start shortly after the motor contactor is energized.

PROBLEM/PROBABLE CAUSE	TEST/SOLUTION
Motor Does Not Start/Low Line Voltage	Check the power supply voltage at L1 and L2. The voltage should be between 195 and 230 volts. If not, check the power cord, the plug, and the main building power supply. / Repair as necessary.
— / **Motor Contactor**	Check to see that the motor contactor closes when energized. If not, check the control circuit and control coil. If the contactor closes, check the voltage between L1A and L2A and between L1A and T3. If either voltage is low, inspect the connector for burned or pitted points. / Replace the contactor or points as necessary.
— / **Motor Overload Relay**	Check the overload relay to see if it is tripped. / Reset the relay. (The correct setting for the overload relay is 18 amps.) Check the current if the relay continues to trip. / Repair the cause of the overload. Check the voltage between T1 and L2B and between T1 and T2. If either voltage is low, check the overload relay for burned or pitted points. / Replace the overload relay or points as necessary.
— / **Motor Faulty**	Test the motor by disconnecting the T1, T2, T2A, T3E, and T3F wires from the motor and connecting three-phase power directly to the motor. Connect L1 to leads 1 and 7, connect L2 to leads 2 and 8, and connect L3 to leads 3 and 9. If the motor starts and runs under a load, the current should not exceed 14.5 amps per leg. / Replace the motor if it does not run or if the current is too high. ***NOTE: With the phase converter connected to the motor, the current per leg will vary with the line voltage and, in general, will not be the same in all legs.***

PROBLEM/PROBABLE CAUSE	TEST/SOLUTION
— / **Current Relay**	Check the voltage between T1 and T2 at terminal 1 of the current relay and between T1 and T2A at terminal 3 of the current relay. If there is voltage between T1 and T2, but not T1 and T2A, the control coil is open. / Replace the current relay. Check the voltage on 7EB at terminal 2 of the current relay with unit control voltage (12 to 14 volts dc) present at 7EA on terminal 4 of the current relay and the current relay energized (current in T2A above 30 amps). If there is no control voltage or low control voltage on 7EB when the current relay is energized, the current relay is defective. / Replace the current relay.
— / **Motor Start Relay**	Check the voltage on 7EC at the motor start relay with unit control voltage (12 to 14 volts dc) present on 7EA and 7EB at the motor start relay. If there is no control voltage or low control voltage on 7EC, the motor start relay is defective. / Replace the motor start relay.
— / **Motor Start Contactor**	Line voltage must be present between T1 and T3 and T1 and T31 at the motor start contactor. If not, check T3 from the motor contactor to the start contactor. / Repair T3 as necessary. Check the voltage between T1 and T3C and T1 and T3D with control voltage present on 7EC at the motor start contactor. Line voltage should be present. If no voltage is present, the control coil of the start contactor is defective. If low voltage is present, the points are defective. / Repair or replace the contactor or points as necessary.

PROBLEM/PROBABLE CAUSE	TEST/SOLUTION
— / **Start Capacitors**	Voltage Test With line voltage present between T1 and T3C and T1 and T3D at the start capacitors, check the voltage between T1 and T3E and T1 and T3F. Both voltages should be within 10% of line voltage. If one of the voltages is low, the start capacitor in that circuit is defective. / Replace as necessary. Current Test (***NOTE: Only one of the two T3E and one of the two T3F wires connected to the motor will carry a current while starting***.) Check the current through T3E and T3F at the motor with an inductive ammeter during a start attempt. The current in each wire should be 30 to 45 amps. If one of the currents is low, the start capacitor in that circuit is faulty. If both the currents are low, the motor start contactor did not close. / Replace as necessary.
Motor Starts But Runs Poorly Or Slows Down and Restarts	
— / **Run Transformer**	With line voltage present between L1A and L2A at the primary winding of the run transformer, check the voltage between T3 and T3A and between T3 and T3B at the secondary windings of the run transformer. The voltages should be 122 (+ 13/-8) volts. If either voltage is less than 110 volts, the line voltage is low or the run transformer is defective. / Replace as necessary. ***NOTE: The transformer has a 208 volt tap and a 230 volt tap. These taps are accessible on the test strip as L1B (208 volts) and L1C (230 volts). Wire L1A should be connected to the tap that matches the line voltage of the power source.***

PROBLEM/PROBABLE CAUSE	TEST/SOLUTION
— / **Run Capacitors**	Voltage Test (This test is valid only if the motor is running at normal speed and the motor start contactor is de-energized.) Check the voltage between T3A and T3E and between T3B and T3F at the test point strip. The voltages should be within 10% of the sum of the line voltage and the secondary transformer voltage. If the voltage is low, the run capacitor in that circuit is defective. / Replace as necessary. Current Test (This test is valid only if the motor is running at normal speed and the motor start contactor is de-energized.) ***NOTE: Only one of the two T3E and one of the two T3F wires connected to the motor will carry a current while running.*** Check the current in T3E and T3F at the motor with an inductive ammeter. Both currents should be 4 to 8 amps. If a current is below 4 amps, the run capacitor in that circuit is defective. / Replace as necessary.

PROBLEM/PROBABLE CAUSE	TEST/SOLUTION
— / **Electric Motor Runs Hot or Loads the Diesel Engine During Diesel Operation**	
— / **Electric Motor Acting As An Induction Alternator**	Check the voltage at the overload relay, T1 to T2, T2 to T3, and T3 to T1. Check the voltage between T3E and T3F. The voltage on any of the above pairs of wires should not exceed 15 volts AC while the unit is running on diesel operation. If the voltage on any of the above pairs of wires is between 500 and 700 volts AC, the electric motor is acting as an induction alternator. To repair the unit, check the following 1. Check the T2 and T3 circuits through the motor contactor to make sure they are open during diesel operation. / Replace or repair the motor contactor as necessary. 2. Check the connections between the electric motor leads and the Thermo King wiring in the connection box on the electric motor. Compare these connections to those indicated in the wiring diagrams and schematics. / Repair the wiring connections as necessary. 3. Disconnect the electric motor leads from the Thermo King wiring at the connection box on the electric motor. Check the wiring in the electric motor with an ohmmeter to make sure the wires have continuity and are labeled correctly according to the wiring diagrams and schematics. / Repair as necessary.

CAUTION: If the electric motor is being rewound, it must be rewound to the factory specifications because this special application requires the phases to be split.

Full Load Current Test—Used to check the overall performance of the phase conversion system.

Use an inductive ammeter to check the current in motor leads 1 and 7, 3 and 9, and 2 and 8. The wires should have the following currents:

Leads 1 and 7 together—8 to 18 amps

Leads 3 and 9 together—10 to 14 amps

Leads 2 and 8 together—9 to 14 amps

The three motor windings will exhibit a slight imbalance of currents. A difference of as much as 6 amps is possible.

The currents through L1 and L2 can be as high as 85 amps while starting, and as high as 23 amps when running at normal speed in high ambient temperatures. High suction pressure settings can cause high current values.

Quantity	Description	Part Number
1	Electric Motor	104-466
1	Motor Contactor	44-2853
1	Overload Relay	44-9712
1	Current Relay	44-8755
1	Motor Start Relay	41-0895
1	Motor Start Contactor	44-2853
1	Transformer	44-9947
2	Start Capacitors	44-8758
2	Run Capacitors	44-8757
1	Filter Capacitor	44-8759
2	Run Capacitor Resistors	44-8760
2	Start Capacitor Resistors	44-8761

Parts List for the CD-II MAX Single-Phase Electric Motor System

CYCLE-SENTRY OPERATION

The description of operation is to be used with the flow chart on the adjacent page. When the unit requires start-up, power comes from either the box temperature thermostat, block temperature thermostat, or defrost relay. the box temperature thermostat supplies power if the box temperature requires a start up. The block temperature thermostat supplies power if the engine temperature is too cold and requires a start up to maintain its temperature, or the defrost relay supplies power if defrost has been initiated and requires start up. Power is supplied to the CYCLE-SENTRY module, the preheat relay, run relay and the start relay. The CYCLE-SENTRY module will provide a ground circuit to each relay in the sequence of operation. The CYCLE-SENTRY module energizes the preheat relay which supplies power to the glow plugs and the fuel pump relay. Preheating occurs until the engine starts. The block temperature thermistor also feeds a signal to the CYCLE-SENTRY module which establishes the proper preheat time depending upon engine block temperature. After the proper preheat time, the CYCLE-SENTRY module energizes the run relay. The run relay supplies power to the fuel solenoid, the fuel pump and energizes the preheat buzzer. The preheat buzzer will continue to sound until the glow plugs no longer have power supplied to them. The fuel solenoid circuit also supplies power to the engine reset switch. The CYCLE-SENTRY module will continue to energize the run relay as long as engine operation is required.

Five seconds after the CYCLE-SENTRY module has energized the run relay, the starter relay is energized. The starter relay energizes the starter, causing the engine to crank. The CYCLE-SENTRY module also energizes a 30 second maximum cranking signal internally while the starter is cranking. When the starter cranks the engine, the RPM sensor produces a signal indicating that cranking or running has occurred. The cranking signal must be above 50 rpm within 4 seconds and the running signal must be above 600 rpm or shut down will occur. When this signal indicates the engine is running, the CYCLE-SENTRY module de-energizes the preheat relay and the starter relay, leaving the engine running.

The engine remains running until all of the following have occurred:

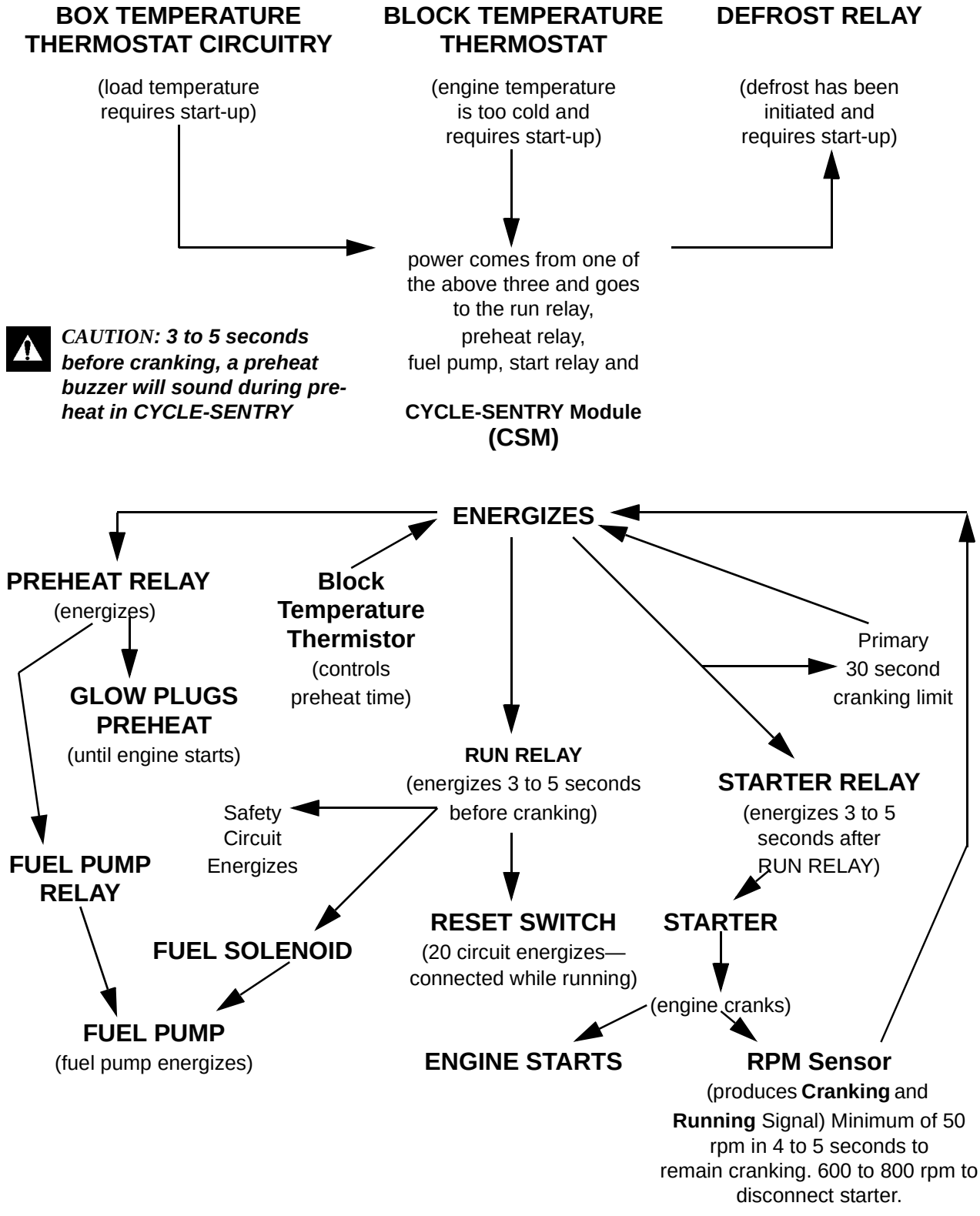
1. The box temperature has been satisfied (box temperature at setpoint).
2. Engine temperature is above 90 F (32.2 C). (Engine is warm enough).
3. Unit is not in defrost.

When the above three items are satisfied, the unit will shut down.

The CYCLE-SENTRY module supplies power to the start relay at the appropriate time to engage the starter motor. The start relay control circuit is wired to a 12 volt positive circuit and to pin 1 of the CYCLE-SENTRY module. When the proper preheat time has occurred, the ground will be completed on the start relay through the pin 1 of the CYCLE-SENTRY module. At that time, the start relay will feed power to the starter motor causing the engine to crank.

CYCLE-SENTRY TRUCK UNIT OPERATION

The Automatic Start-Stop operation requires that all devices perform properly and in the proper sequence. Understanding this sequence is important to understanding the operation of the unit.



Functional Chart

Components	Preheating	Cranking	Running	Null	Protection (Reset Tripped)
CYCLE-SENTRY Module	Timing pre-heat	Timing cranking, Monitoring engine speed of more than 50 rpm and less than 800 rpm. Max time crank-ing 30 sec	Monitors engine speed of more than 800 rpm and then locks out preheat and cranking	De-energized	De-energized
Run Relay	De-energized	Energized	Energized	De-energized	De-energized
Start Relay	De-energized	Energized	De-energized	De-energized	De-energized
Preheat Relay	Energized	Energized	De-energized	De-energized	De-energized
Green Start-Stop Light	On	On	On	On	Off
Fuel Solenoid	De-energized	Energized	Energized	De-energized	De-energized
Glow Plugs	Energized	Energized	De-energized	De-energized	De-energized
Reset Switch	Disconnected	Disconnected (trips approxi-mately 30 seconds) after engine stops cranking on a no start condition (no oil pressure)	Connected to protection switches	Disconnected	Tripped

CYCLE-SENTRY Checkout and Diagnosis

Use this checkout procedure to determine if the CYCLE-SENTRY is operating properly. This procedure should be used to check out new units, check out units after field installations have been made and check out units when an operating problem is reported.

Prior to effective diagnosis of the CYCLE-SENTRY, it is necessary to determine the exact nature of the problem. To do this, it is first necessary to run the unit in the Continuous Run mode to determine if the problem also exists in that mode. If the problem does exist in the Continuous Run mode of operation, then it is necessary and easier to trouble-shoot and repair the problem in that mode. To determine if the unit is operating properly, start the unit in Continuous-Run and perform a THERMOSTAT switch sequence test (see Thermostat Checkout). Test the defrost operation by grounding the 12 circuit and pressing the MANUAL DEFROST switch. The unit should go into defrost. Disconnect the 12 circuit from ground, and the unit should terminate defrost if the defrost termination switch is open.

Start-Stop Operation Checkout

CAUTION: With the selector switch in AUTO START-STOP position and the unit ON/OFF switch in the ON position, the unit may start at any time without prior warning.

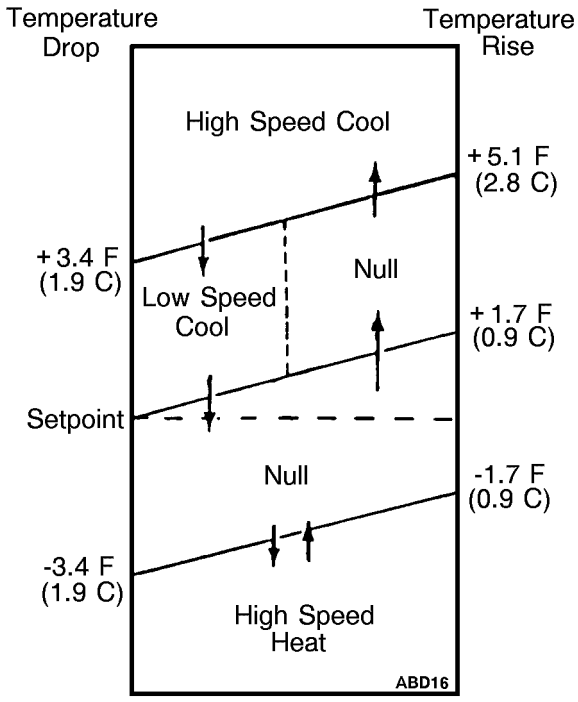
1. Place the START-STOP/CONTINUOUS RUN selector switch in AUTO START-STOP position.
2. Set the thermostat to -20 F (-29 C).
3. Turn the ON/OFF switch to the ON position. The green start-stop light on the control panel should be on.

   NOTE: Preheat duration will vary depending on engine temperature. Preheat time is approximately 5 seconds at 150 F (66 C) to 120 seconds at -20 F (-29 C).

4. At the completion of the Preheat cycle, the unit should crank, start and run on high speed cool.
5. Set the thermostat from -20 F (-29 C) to +80 F (27 C). The unit should go from high speed cool to low speed cool and go into null (engine off) at setpoint. The green START/STOP light should be the only light energized after the unit shuts off

   NOTE: The unit will not go to null until the engine is warmed up (block temperature switch open). When this occurs, the unit will run in low speed heat until it shuts down in null.

6. With the unit in null, slowly set the thermostat up to +80 F (27 C). The unit should preheat, crank and run in high speed heat.
7. Set the thermostat at null.



AUTO START-STOP Operation

Start-Stop Operation Checkout (continued)

8. With the unit in null, connect a jumper wire from #12 circuit to a chassis ground (CH). Depress the MANUAL DEFROST switch. The DEFROST light should come on. The unit should preheat, crank and run in defrost until the jumper is removed if the DEFROST TERMINATION switch is open.

9. Turn the unit ON/OFF switch to the OFF position. Disconnect the BLOCK TEMPERATURE switch at the harness plug connection located behind the engine and pull this section of the harness to an accessible position.

CAUTION: Do not route the wires through the belts.

10. Set the ON/OFF switch to the ON position. Rotate the thermostat to the HIGH SPEED COOL position and allow unit to start and run. Set the thermostat to Null mode.

11. Allow the unit to cycle off in the Null mode.

12. Connect a jumper across plug pins (wires 8B and 7A) disconnected in step 9. The unit should preheat, crank and run.

13. Disconnect the jumper wire between the plug pins (wires 8B and 7A) connected in step 12. The unit should return to null. Snap the ON/OFF switch into the OFF position, and reconnect the plug to the BLOCK TEMPERATURE switch located behind the engine.

14. Connect a voltmeter across the positive and negative post of the battery. Monitor the battery voltage during the cranking limit test outlined in step 15. An acceptable battery with a full charge should not drop below 9 volts at 80 F (27 C) during the cranking period of 30 seconds. If the battery was fully charged and the voltage drops below 9 volts during cranking, the battery condition is marginal and the battery must be replaced for dependable Start-Stop operation.

15. Disconnect the fuel solenoid wire (8D) and set the thermostat to -20 F (-29 C). Snap the ON/OFF switch into the ON position. The unit should preheat and crank for 30 seconds. The cranking limit time should not exceed 30 seconds. At the end of 30 seconds, the unit should discontinue cranking, and the RESET switch should trip.

16. With the fuel solenoid wire disconnected, disconnect the FS1 or FS2 wire from the flywheel sensor. Turn the ON/OFF switch to ON. The unit should preheat and crank for approximately 5 seconds only since no minimum cranking rpm signal is being received from the flywheel sensor. At the end of 5 seconds, the unit should discontinue cranking and the RESET switch should trip. Turn the switch OFF and reset the RESET switch.

17. Reconnect the fuel solenoid and flywheel sensor wires and allow the unit to start and run in High Speed Cool. With the unit running, disconnect either the FS1 or FS2 wire from the flywheel sensor and observe that the unit does not attempt to preheat or crank with the unit running.

18. Reconnect the flywheel sensor and turn the switch OFF.

After completing the checkout of the Start-Stop mode of operation, determine the condition causing the problem and relate that condition to conditions found in the diagnosis chart in the back of this manual. By using the diagnosis chart, the probable cause can be checked and the problem determined in a minimal amount of time.

Component Tests

NOTE: All voltage and resistance readings are measured with a Simpson 260 meter. Use of other meters may give different readings because of variations in internal meter circuitry. Before relying on other meters, compare meter readings with those obtained on the same component using a Simpson 260.

OPTION CIRCUIT BOARD

The printed circuit board assembly contains the CYCLE-SENTRY module socket, the preheat relay socket, the run relay socket, the Whisper relay socket, the on relay socket and a preheat indication buzzer.

CAUTION: A preheat buzzer will sound five seconds before cranking to indicate the unit is in the Preheat mode.

Refer to the CYCLE-SENTRY Operation and Diagnosis Manual for all operation and diagnosis procedures. The CD-II MAX is not presently included in that manual but the system is similar.

Option Board Jumpers

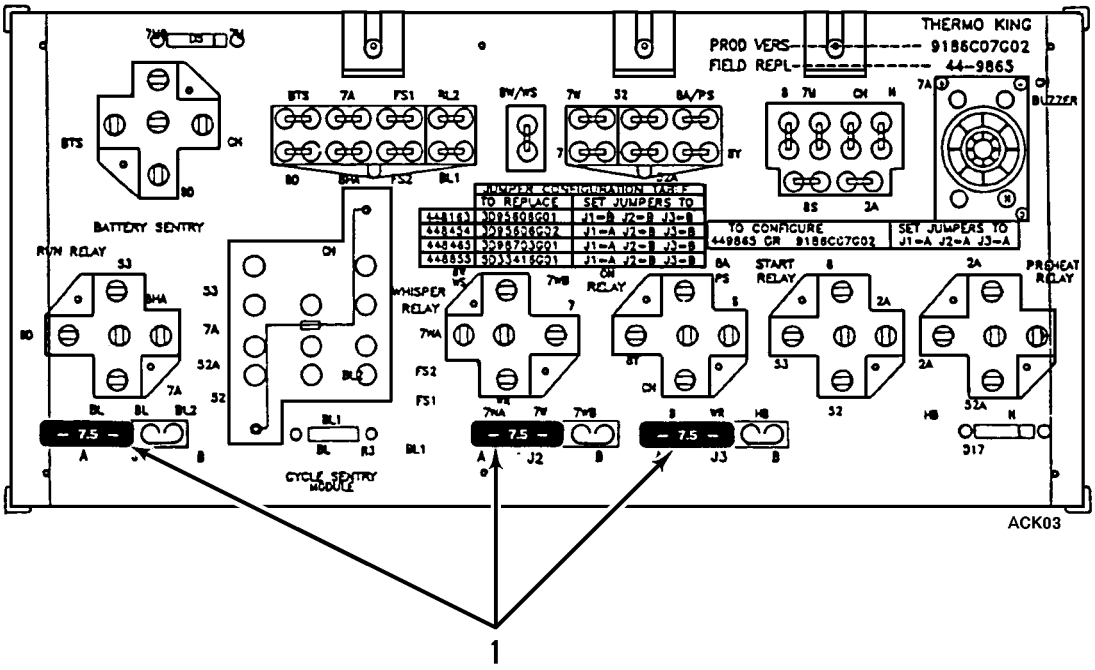
The option board has three 7.5 amp fuses that are used as jumpers to configure the board for different applications. If these jumpers are not in the correct positions, the unit may not function properly. The correct jumper positions for the CD-II MAX are: J1—Position A, J2—Position A, J3—Position A.

When requesting board TK No. 44-9865, six (6) additional nylon washers MUST BE ordered (TK No. 55-7585).

SWITCH PANEL CIRCUIT BOARD

This circuit board contains two circuit breakers that protect the unit. One breaker, the 50 amp remote reset is located between the 2A and 2B circuits on the circuit board. This breaker is designed to trip in the event of an overload on either the 2B circuit, starter solenoid or glow plugs. The second breaker is a remote reset 20 amp breaker that protects the 8 series operation circuits.

NOTE: The 50 amp circuit breaker and the 20 amp circuit breaker can be reset by turning the unit ON/OFF switch OFF for 60 seconds. This will allow the bi-metal strip in the breaker to cool and reset. The printed circuit board contains several diodes and resistors. These can be checked by turning the unit OFF and checking them with an ohmmeter. The diodes should show no continuity in



1.	Correct Jumper Positions

Option Board

one direction and continuity (10 to 20 ohms) in the other. The resistors can be checked with an ohmmeter by placing the test leads across the resistor. The resistor should show continuity within 10% of the value listed in the wiring diagram. Diodes can be replaced with P/N 44-3400 and resistors of 1/2 watt size.

NOTE: Flat washers are used between the board and circuit breakers. These must be used when replacing circuit breakers.

Use a de-soldering tool, 60-40 resin core solder and a low wattage soldering iron.

Some things to note are:

- The current paths on the circuit board can be damaged (scratched, etc.) and cause an open circuit.
- A feed through hole may burn out between the top and bottom surfaces.
- If either circuit board is damaged, they must be replaced. They cannot be repaired.

CYCLE-SENTRY ELECTRONIC MODULE

The CYCLE-SENTRY Module (CSM) is the heart of the CYCLE-SENTRY system. All CYCLE-SENTRY modules are orange colored to distinguish them from the time delay modules which are light blue colored and were used in the CYCLE-SENTRY system and the starter disconnect timer used in the truck units.

The CYCLE-SENTRY module plugs into the CYCLE-SENTRY printed circuit board and controls the preheat relay. The control coil of the preheat relay is wired to a 12 volt positive circuit and to pin 4 of the CYCLE-SENTRY module. When preheat is required, the CYCLE-SENTRY module completes the ground on pin 4 causing the preheat relay to energize. When the preheat relay energizes, the glow plugs will be fed power causing preheating to occur. The proper preheat time is determined by the engine block temperature thermistor located on the back side of the engine block. This temperature thermistor is connected to pins 2 and 5 of the CYCLE-SENTRY module. The CYCLE-SENTRY module interprets the resistance of the thermistor, and in turn delays the engagement of the start relay long enough to give the proper preheat time. The preheat time will vary from 5 seconds on a hot engine to 120 seconds on a cold engine.

CYCLE-SENTRY Module #44-7192

CD-II MAX units must use Module #44-7192, designed specifically for CYCLE-SENTRY requirements. This module has all of the operating features of the CYCLE-SENTRY module (#44-6874), but also has an additional run relay timed input control on pin “A”. This relay is used on CYCLE-SENTRY systems to give proper run relay and fuel solenoid operation.

NOTE: If a #44-6874 CYCLE-SENTRY module is erroneously installed in the CD-II MAX CYCLE-SENTRY circuit board, the unit will preheat and crank automatically, but the fuel solenoid will not energize and the unit will not start.

Initial Crank Protection

The CYCLE-SENTRY module has a protection feature which assures positive engagement of the starter and proper cranking of the engine. Approximately 4 to 5 seconds after the start relay is energized and the starter motor begins cranking, the engine must be rotating a minimum of 50 rpm or the cranking attempt is ceased. This is designed so that if the starter fails to engage in the ring gear of the flywheel or if the engine fails to turn over for any reason, power would not be applied to the starter continually for 30 seconds. This feature will give maximum protection against extreme starter or ring gear damage in the event the starter fails to engage. After the cranking attempt is terminated, the RESET switch will trip approximately 40 seconds after cranking started, allowing a complete shutdown of all electrical circuits.

Failure to Start Protection

The CYCLE-SENTRY module also has a 30 second maximum cranking limit feature built into it. Whenever the start relay is engaged by the CYCLE-SENTRY module, an electronic timer inside the module begins timing out the cranking limit protection. If the engine continuously cranks for approximately 30 seconds without starting, the CYCLE-SENTRY module de-energizes both the start relay and the preheat relay. This terminates all cranking. After this occurs, the RESET switch trips causing a total shutdown of all electrical circuits.

Starter Re-engagement Protection

The CYCLE-SENTRY module is also designed so the start relay and the preheat relay are locked out 30 seconds after the starter is engaged. The start relay and the preheat relay are locked out until the 7A power is removed from the CYCLE-SENTRY module, indicating the thermostat has been satisfied. This feature prevents the preheat and starter engagement from reoccurring on a running engine if a failure occurs on an rpm sensor or in the circuit connecting the rpm sensor to the CYCLE-SENTRY module.

Testing The CYCLE-SENTRY Module

The CYCLE-SENTRY module can be tested in three ways

1. It can be exchanged with a known good module. This type of testing is usually a very fast and effective method to determine defective modules
2. It can be tested in a CYCLE-SENTRY module tester available under P/N 204-571 and adapter P/N 204-637. This method of testing is also very fast and effective; however, it does require the tester and adapter to be available. The specific instructions regarding use of this tester and adapter are covered later in this section.

Testing the CYCLE-SENTRY module using the special module tester P/N 204-571 and special module adapter P/N 204-637

Equipment required:

- CYCLE-SENTRY module tester P/N 204-571
- Special CYCLE-SENTRY module adapter P/N 204-637
- 12 volt battery or DC power supply

Procedure

1. Attach the red (+) and black (-) leads from the CYCLE-SENTRY module tester to a 12 volt power source such as a 12 volt battery or 12 volt DC regulated power supply available under P/N 204-572.
2. Turn the POWER switch to the OFF position.
3. Insert the CYCLE-SENTRY module adapter P/N 204-637 in the right hand socket identified STD-CSM. The (CSM) refers to the CYCLE-SENTRY module.

4. Insert the CYCLE-SENTRY module into the special adapter. CYCLE-SENTRY modules are uniquely identified with an orange case and the P/N 1189A98G07. Other modules with an orange case are CYCLE-SENTRY modules (CSM); modules that have a light blue case are TIME DELAYS (TD) or STARTER DISCONNECT TIMERS (SDT). Make sure the module being tested is the appropriate one and the appropriate socket is being used.

5. Turn the POWER switch ON. The yellow light (A) on the tester should come on indicating the unit is in the testing mode. The G06 LED on the special adapter should also be on.

Module Tester P/N 204-571 and Special Test Module Adapter P/N 204-637

6. After 10 to 12 seconds of power ON, the G06 LED should go out and the G07 LED should come on.

7. After 18 to 20 seconds of power on time the:

   a. Amber light (A) on the tester turns off.

   b. Green light (B) on the tester turns on.

   c. G07 LED on the module adapter stays on.

8. If the red light labeled “C” on the tester is lit, then this indicates a failed module.

   NOTE: This completes the first part of the test. The second part of the test must also be completed to verify a totally good module.

9. Turn the POWER switch OFF.

10. Turn the POWER switch on and hold down the button labeled “CSM SHORT CYCLE TEST.” At this time, the yellow light (A) should come on. Continue holding the SHORT CYCLE TEST button down. After approximately 10 seconds, the tester should light the red light (C). This red or reject light indicates that the CYCLE-SENTRY module is performing satisfactorily on the short cycle test.

11. Turn the POWER switch OFF, disconnect the CYCLE-SENTRY module, and remove the tester from the power supply.

Preheat, Starter and Run Relays

These are SPDT 12 Volt DC relays. The preheat relay supplies power to the glow plugs. The starter relay is energized through the CYCLE-SENTRY module after proper preheat time has occurred. When this relay energizes, the starter solenoid receives power and the engine cranks. When the run relay energizes, the contact supplies power to the fuel solenoid, the fuel pump and the RESET switch. These relays are identical and interchangeable.

To Test the Relays

When the relay is de-energized, there is continuity between pins 30 and 87a. There should be no continuity between pins 87 and 30. When the relay is energized with 12 Vdc positive power supplied to pin 85 and CH to pin 86, the relay contacts will close, and there should be continuity between pins 87 and 30.

To Test the Relays (continued)

There should be no continuity between pins 30 and 87a. Disconnect the 12 V dc to pins 85 and 86. The relay contacts should open.

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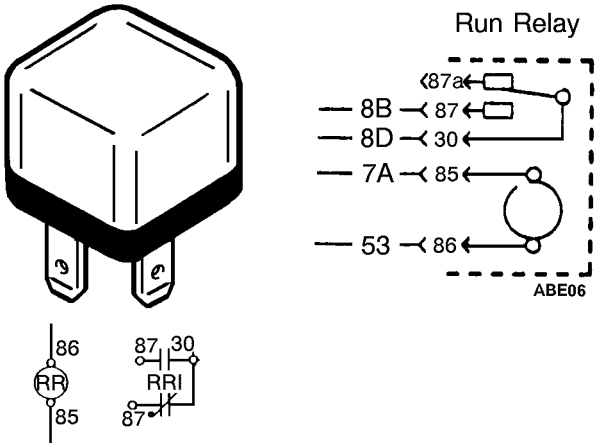


Relays with Wiring and Schematic Diagram Symbols

Preheat Relay

If the preheat relay fails in the open position, the glow plugs would not preheat and the engine may not start, resulting in the cranking time limit being exceeded. If the preheat relay failed in the closed position, the glow plugs would remain on.

Run Relay

If the run relay fails in the closed position, the unit would run continuously as in the Continuous Run mode of the operation. If the relay fails in the open position, the fuel solenoid would not stay in on low speed.

Start Relay

If the start relay fails in the open position, the engine would not crank. If the relay failed in the closed position, the starter would continue to crank after the unit started.

PREHEAT BUZZER

The preheat buzzer module on the circuit board is designed to indicate preheat is in operation.

ENGINE RESET RELAY

CD-II MAX units with CYCLE-SENTRY have an engine reset relay added to the engine reset circuit. This relay is located in the control box.

The engine reset relay supplies battery voltage to the resistor in the ENGINE RESET switch if the HIGH PRESSURE CUTOUT switch opens. Battery voltage on the resistor will cause the engine reset to trip if the engine stopped running because the HIGH PRESSURE CUTOUT switch opened.

The 8H circuit energizes the relay during normal operation. If the 8H circuit is de-energized, a set of contacts in the relay close and connect the 8 circuit to the 7KB circuit. This switching supplies battery voltage to the resistor in the ENGINE RESET switch.

CAB CONTROLS

CD-II MAX units ordered with the standard cab control option have an ON/OFF switch, a DEFROST switch, a WHISPER (idle) switch, and a thermometer mounted in a DIN box. The standard cab control option has a feature called Auto-Start. The Auto-Start system uses a CYCLE-SENTRY module to automatically start the unit whenever the unit is turned on. A CYCLE-SENTRY cab control option that automatically starts and stops the unit can also be ordered.

The ON/OFF switch in the cab control box energizes the CYCLE-SENTRY module. The CYCLE-SENTRY module controls relays located on the option board that preheat, start, and run the engine. Since the CYCLE-SENTRY module is energized by the ON/OFF switch (not a Battery Sentry or the thermostat), once the engine is started it will run until the unit is turned OFF.

CAUTION: The unit will always automatically start when both the unit ON/OFF switch and the cab control box ON/OFF switch are turned ON.

TROUBLESHOOT THE AUTO-START SYSTEM USING CYCLE-SENTRY DIAGNOSIS PROCEDURES

A WHISPER (idle) switch is located in the cab control box. When this switch is in the WHISPER position, the engine will always run in low speed. The engine will start in high speed but it will return to low speed after it is first started. The whisper relay on the option board energizes the high speed solenoid whenever the H circuit is energized.

The PREHEAT/START switch on the unit switch panel allows an operator to manually preheat and start the unit.

RPM SENSOR

The rpm sensor is in the engine bell housing adjacent to, but not touching, the flywheel (backed off 1/2 turn).

The rpm sensor is a device containing an inductance coil and magnet. When the magnetic field is distorted by the passing ring gear teeth, the inductance coil generates an ac electrical signal that has a voltage and frequency variation proportional to the engine rpm.

By monitoring the frequency of this signal with the starter disconnect module, the timing of the starter disengagement can be precisely controlled.

If the rpm sensor fails, the starter may not disengage or engage properly.

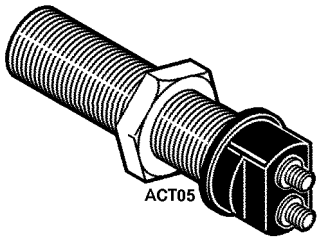
Testing the RPM Sensor

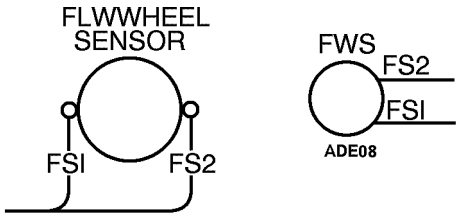
Equipment required:

- AC voltmeter capable of reading up to 10 volts
- Ohmmeter
- CYCLE-SENTRY Stop-Start unit with bracketry for installing the rpm sensor.

The rpm sensor may be checked as follows:

1. Install the rpm sensor into the flywheel bracket of the start-stop unit until it contacts the ring gear. Back out the sensor 1/2 turn and tighten the lock nut.





RPM Sensor

2. Disconnect wires (FS1 and FS2) from the sensor.

Testing the RPM Sensor (continued)

3. Switch CYCLE-SENTRY to Continuous Run. Run the unit on low speed and high speed. Check the AC voltage output across the sensor terminals. Use a meter with a high ohms per volt internal resistance. A Simpson 260, Fluke digital or any good VOM will work. However, an automotive type meter may not give an accurate reading because the meter may load the circuit heavily and cause the voltage level to appear lower than it actually is.

   a. The output voltage should be 1.0 to 2.0 Vac on low speed.

   b. The output voltage should be 2.0 to 2.5 Vac on high speed.

   NOTE: If the voltage is slightly off, the voltage may be increased by turning the sensor in more, and the voltage may be lowered by turning the sensor out more.

4. Reconnect FS1 and FS2 wires on rpm sensor.

If the rpm sensor passes the above test, the sensor may be considered good.

If the unit is not available, an alternate less reliable test may be performed as follows:

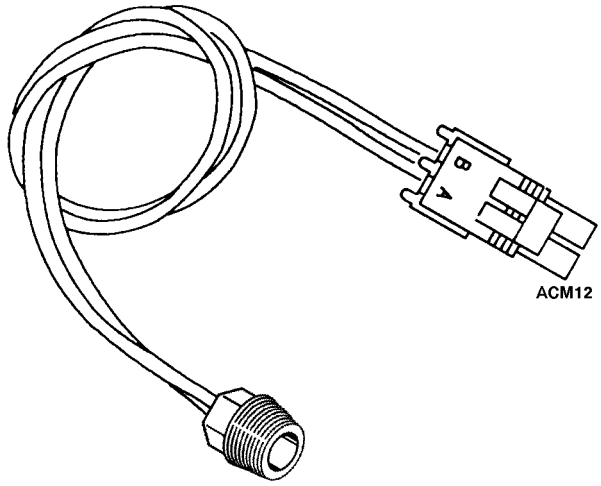
- Disconnect the sensor from all wires, and measure the resistance across the terminals and from each terminal to the aluminum case. The resistance should be 250 to 300 ohms across the terminals, and there should be no continuity from each terminal to the case.

TEMPERATURE COMPENSATING THERMISTOR

The block temperature compensating thermistor is a bolt type thermistor located in a bolt hole in the rear of the engine block. This location is one of the bolts that holds the BLOCK TEMPERATURE switch in position on the engine. It is readily identified by two wires seemingly coming from the center of the bolt.

The temperature compensating thermistor is a variable resistance device that reacts to temperature. As the temperature increases, the resistance value decreases. The thermistor controls the amount of preheat time. This allows an optimum preheat time of 5 to 120 seconds, depending upon the engine temperature.

If the thermistor fails in the OPEN position, the preheat time would always be extremely long. This preheat time would be approximately 120 seconds before cranking would begin. If the thermostat fails in the SHORTED position, the preheat time would not be sufficient to properly preheat the engine, and the cranking time would probably exceed the cranking time limit of 30 seconds on extremely cold engines.



Temperature Compensating Thermistor

Testing the Temperature Compensating Thermistor

Equipment required:

- Ohmmeter
- Method of cooling and warming the sensor

1. Check the resistance of the thermistor with an ohmmeter set on the Rx10,000 scale.
2. The resistance of the bolt-type sensor will be 35,000 to 65,000 ohms at 70 F (21 C). At 180 F (82 C), the resistance will be 1,000 to 10,000 ohms.

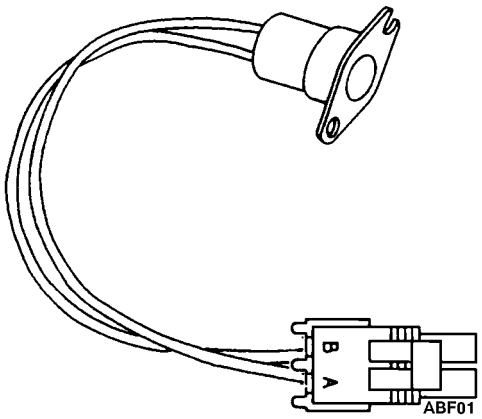
   The resistance decreases as the temperature increases and increases as the temperature decreases. A faulty sensor shows no change in resistance as the temperature changes
3. Check the resistance from either lead to the surface of the bolt or chassis ground. There must be infinite resistance or no continuity to the surface of the bolt or chassis ground.

If the thermistor passes the above tests, it may be considered good.

BLOCK TEMPERATURE SWITCH

The BLOCK TEMPERATURE switch is located on the rear of the engine block. This switch is very similar to a DEFROST TERMINATION switch. When the temperature is below 30 F (0 C), the switch closes, and there will be continuity through its connections. If the temperature rises above 90 F (32.2 C), the switch opens, and there will be no continuity between its connections. This switch is used to make sure the engine temperature is never allowed to drop to an extremely cold state preventing automatic start-up and is also to ensure that once start-up has occurred, the engine will be brought up to a satisfactory temperature prior to shut down.

If the block temperature switch fails in the CLOSED position, the unit starts up and runs continuously and would not shut off when the setpoint has been reached on the thermostat. Basically, the unit would operate as it normally would in the CONTINUOUS RUN position. If the block temperature switch fails in the OPEN position, the engine would not automatically be started if the temperature dropped below 30 F (0 C), and the problem of a no-start situation could occur in extremely cold ambients. Also, the engine would not always come up to operating temperature if the load temperature thermostat was satisfied in a short period of time. This would result in short cycling a cold engine and could result in excessive engine wear and extremely short cycling of the thermostat in cold ambients.



Block Temperature Switch

Testing the BLOCK TEMPERATURE THERMOSTAT Switch

Equipment required:

- Ohmmeter
- Method of cooling the switch below 30 F (0 C) (deep freeze, R-404A, etc.)
- Method of heating the switch above 90 F (32.2 C) (trouble light bulb, controlled torch, etc.).

1. Connect an ohmmeter set on the Rx1 scale across the leads of the BLOCK TEMPERATURE switch.
2. Cool the switch below 30 F (0 C) and allow the temperature of the switch to stabilize (may require several minutes). When the saturated temperature of the switch is below 30 F (0 C), there should be continuity across the terminals.
3. Warm the switch above 90 F (32.2 C), and allow the temperature of the switch to stabilize (may take several minutes). When the saturated temperature of the switch is above 90 F (32.2 C), there should be no continuity across the terminals.
4. If the block temperature switch passes the above tests, it may be considered good.

RESET SWITCHES

ENGINE RESET Switch

The engine is protected by a manually reset THERMO-BREAKER switch. The RESET switch contains a heating coil that is attached to sensor switches in the engine oil system and engine cooling system.

If one of the sensors is grounded due to an abnormal condition (low oil pressure, high coolant temperature or extended cranking time), the heated coil heats up causing the RESET switch to trip and stop the engine.

It takes approximately 10 to 30 seconds for the coil to heat up and trip the RESET switch.

The RESET switch must be replaced if it is defective.

Summary of reasons for the RESET switch tripping:

1. Coolant temperature excessively high.
2. Lack of engine oil pressure.
3. Lack of fuel to the engine (switch trips because of a lack of engine oil pressure).

   NOTE: If the unit switch is ON with AUTO STOP-START/CONTINUOUS RUN selector switch in the CONTINUOUS RUN position and the engine is not running, the low oil pressure sensor will cause the RESET switch to open.

4. High pressure in the refrigeration system (high pressure cutout shuts down the engine, then RESET switch trips because of engine low oil pressure).
5. Unit exceeds cranking limit on CYCLE-SENTRY operation. If the engine cranks continuously for approximately 30 seconds and fails to start, the CYCLE-SENTRY module stops further cranking attempts. After this occurs, the RESET switch trips in 10 to 30 seconds or less because of engine low oil pressure.
6. A ground fault in the No. 20 or 20A wires to the switches is also a possible cause.

   NOTE: A ground or short circuit in the electrical system does not cause the RESET switch to pop out

STARTING CIRCUIT RESET Switch

This 50 amp manually reset circuit breaker protects the electrical circuit to the engine glow plugs and the starter solenoid.

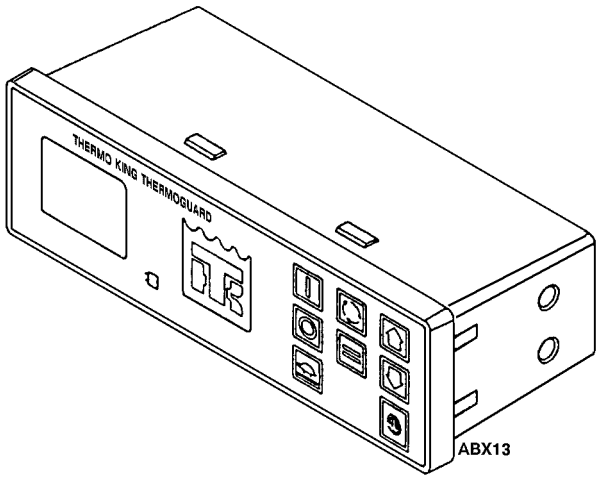
If the circuit breaker opens:

1. Check for a short in one of the glow plugs.
2. Check for a ground in the 2B or H circuits.

Control Circuit Reset Switch

This 20 amp remote reset circuit breaker protects the unit control circuits. This circuit breaker is reset by turning the ON/OFF switch OFF for a minute.

IN-CAB TG-V CONTROLLER



Single Temperature In-Cab TG-V Controller (P/N 41-1544—12V No Modulation)

The In-Cab TG-V functions similarly to the standard unit mounted TG-V. However, the In-Cab TG-V Controller also has the following additional features:

- Alarm Codes for Single Temperature In-Cab TG-V

Alarm Code	Fault Condition
03	Return Air Sensor Faulty
04	Discharge Air Sensor Faulty
14	Defrost Circuit Failure
10 or 19	Refrigeration High Pressure Cutout
25	Battery Charging Alternator Failure
74	Cold Start or Checksum Error
75	Microprocessor RAM Faulty
76	Microprocessor EEPROM Faulty
77	EPROM Faulty
87	Field Test Error
88	Microprocessor Faulty

- Power Cord LED on Model 50 Units
- WHISPER (LOW SPEED) PUSH Button

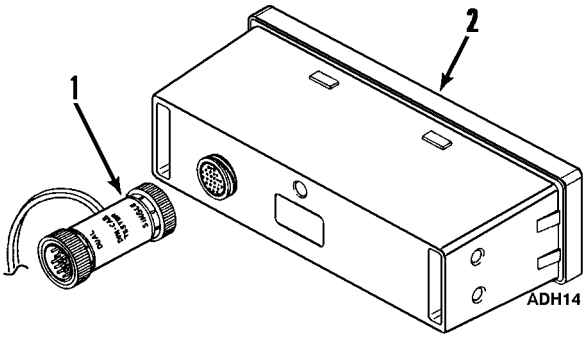
The operating manuals and the setup and operating manuals contain information about the control functions and how to customize the display screens. Manuals for the Single Temperature In-Cab TG-V Controller: Operating Manual (TK 40940) and Operating and Setup Manual (TK 40804).

A stand alone tester is available as P/N 204-831. It will test all In-Cab TG-V Controllers.

Field Test Procedure for Single Temperature In-Cab TG-V Controllers

Use tester P/N 204-831.

1. Connect the end of the tester marked “SINGLE” to the single temperature controller.



1.	Tester Side “SINGLE” Connection
2.	Single Temperature Controller

Connecting Tester to Controller

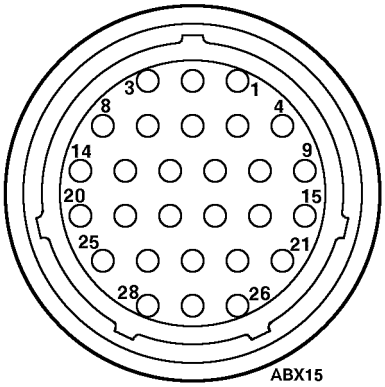
2. Power up the controller by connecting the tester leads to a 12 volt DC power supply.
3. Press the controller’s ON key to display all segments.
   a. The TURTLE icon must be displayed. If not, press the TURTLE key. Alarm Code 19 will be recorded if the TURTLE icon is not displayed.
   b. If the ALARM icon is displayed, press the SELECT key to display the alarm and press the ENTER key to clear the alarm.
4. Press the SELECT key to display the setpoint(s) and adjust the setpoint(s) to 80° F.

NOTE: The controller must be set to display temperatures in the Fahrenheit scale. The test WILL NOT work if the controller is displaying temperatures in the Celsius scale. Refer to the Controller Operating and Setup Manual for information about changing the displayed temperature scale.

5. With the setpoint of 80° F displayed on the screen, press the following keys simultaneously:
   a. SELECT key.
   b. UP ARROW key.
   c. TURTLE key.
6. The display will read “FT”.
   a. All other icons will be off.
   b. The red, Power Cord LED will begin to flash on and off.
   c. All icons will then turn ON for a few seconds.
   d. Then the display will count from 1 to 15.
   e. The display will then read PS for pass, or FC for fail.
   f. Press the OFF key to exit the test.

Connector Pins for Single Temperature In-Cab TG-V

Pin #	Circuit Code	Harness Wire Color Code	Circuit Description
1		WHT/BLK/RED	
2	HGV	WHT/VOIL	Hot Gas Valve (Modulation Only)
3	BATT+	WHT/ORG	Battery Positive
4	MV-	BLUE	Modulation Valve Negative (Modulation Only)
5	BATT-	YELLOW	Battery Negative
6	BATT+	WHT/BLK/ORG	Battery Positive
7	WS	WHT/BLK/YEL	Whisper Relay
8	14T	WHT/RED	Heat Relay
9		WHT/BRN	
10	ACC		Accessory Wire to Truck Ignition
11	PC	WHT/BLK/VOIL	Power Cord (Electric Standby)
12	8B	WHT/BLK/BLU	Cycle-Sentry Input
13	10T	VIOLET	High Speed Relay
14	38	WHT/BLK/BRN	In-Range Output
15		WHT/GRN	
16	INDL	WHT/GREY	Alternator Charging
17	8	WHT/BRN/RED	Power from On-Off Switch
18	SN	WHITE	Return Air Sensor
19	SN	GREEN	Return Air Sensor
20	BATT-	WHT/BLK	Battery Negative
21	11	BRN	Defrost Relay Circuit
22	12	WHT/YEL	Defrost Termination Switch
23	7T	WHT/BLK/GRN	Not Used
24	DSN	BLK	Discharge Air Sensor
25	PS	WHT/BLU	On Relay Coil
26	7K	GREY	Latching Circuit after 8D
27	29	ORANGE	Defrost Damper Circuit
28	DSN	RED	Discharge Air Sensor



Connector on Back of Single Temperature In-Cab TG-V

ENGINE LUBRICATION SYSTEM

The TK 2.49 diesel engine has a pressure lubrication system. Oil is circulated by a trochoid type oil pump driven by the crankshaft timing gear and has several times the capacity required by the engine. Oil is picked up through a suction tube with a screened inlet. Oil to the rocker arm shaft flows through a tube on the outside of the engine and into the head through a restrictor fitting.

Oil pressure is affected by oil temperature, viscosity and engine speed. Subnormal oil pressures usually may be traced to lack of oil, faulty relief valve or worn bearings. The use of improper viscosity oil will also produce low oil pressure shutdowns.

ENGINE LOW OIL PRESSURE Switch

Engine oil pressure should rise immediately on starting. A LOW OIL PRESSURE switch will trip the RESET switch and stop the engine if the oil pressure drops below 10 ± 3 psig (69 ± 21 kPa). A continuity tester is needed to check the OIL PRESSURE switch.

1. Remove the wire 20A from the switch.
2. Continuity tester should indicate a complete circuit between the 20A wire terminal and ground.
3. Start the engine. Tester should show an open circuit between the 20A wire terminal and ground.

Maintenance consists of replacing the switch.

Engine Oil Change

The engine oil should be changed every 750 hours with CG-4 oils or synthetic oil (1,200 hours with CG-4 oils or synthetic oil, with new TK 11-9321 bypass filter) or 6 months, whichever occurs first. Drain the oil only when the engine is hot to ensure that all the oil drains out. When changing oil, try to make sure that the trailer is not tipped away from the direction that the oil is supposed to flow from the oil pan. It is important to get as much of the residual oil out as possible because most of the dirt particles are in the last few quarts of oil to drain out. Refill the pan with 3 quarts (2.8 liters) and check the dipstick level. Run the unit, and then recheck the oil level.

NOTE: Fill the crankcase slowly so oil will not run into the breather hose, thus filling up an open cylinder. Leaving the dipstick out while adding engine oil will vent the crankcase.

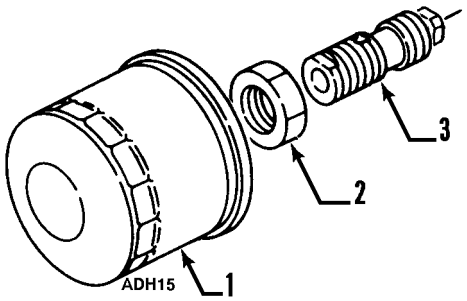
Add oil as necessary to reach the full mark. See Specifications page for correct type of oil.

Oil Filter Change

The oil filters should be changed along with the engine oil.

Spin-on filters:

1. Remove the filter.
2. Apply oil to rubber ring of new filter and install filter.
3. Tighten the filter until the rubber ring makes contact, then tighten 1/2 turn more.



1.	Filter
2.	Pressure Valve Nut
3.	Oil Pressure Valve

Oil Filter Parts

CRANKCASE BREATHER

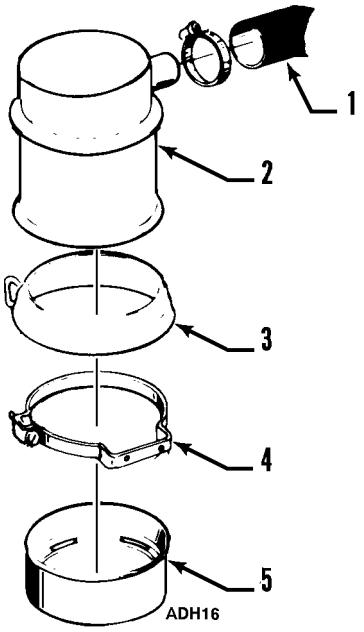
The crankcase breather system ducts crankcase gases formed in the crankcase directly to the intake elbow. Harmful vapors that would otherwise collect in the crankcase and contaminate the oil or escape to the outside, are now drawn back into the engine and burned. The breather hose should be inspected yearly to make sure it is not plugged.

ENGINE AIR CLEANER

Oil Bath Type

A heavy duty, oil bath air cleaner filters all of the air entering the engine. Excessive restriction of the air intake system reduces the flow of air to the engine affecting horsepower output, fuel consumption and engine life.

The air cleaner removes abrasive material from the air entering the engine. The air cleaner must be kept clean and open so that the air can pass freely. If the oil has absorbed the maximum amount of dirt, it allows the dirt to enter the engine. Remove the oil cup, wash thoroughly and dry every 1000 operating hours (500 hours under dusty conditions). Refill using the same weight oil used in the engine crankcase. Inspect the cleaner body and wash in solvent when it becomes dirty.

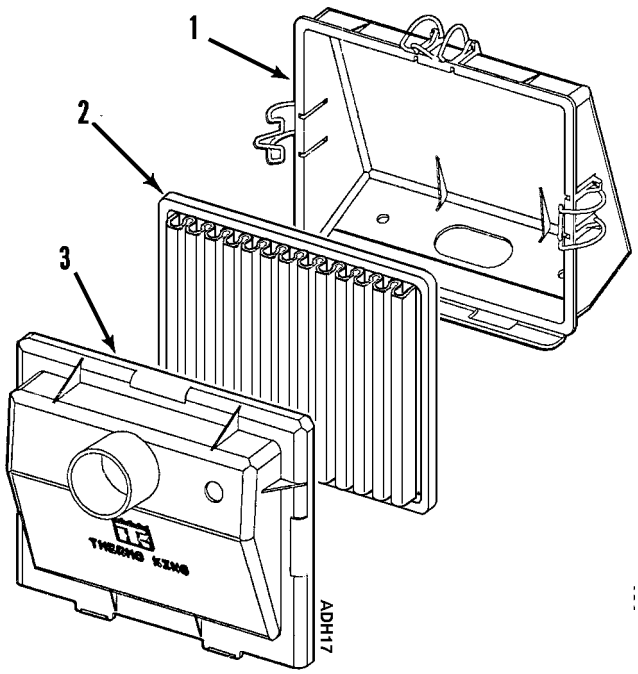


1.	Air Intake Hose
2.	Air Cleaner Filter
3.	Clamp Assembly
4.	Mounting Clamps
5.	Cup

Oil Bath Air Cleaner

Dry Type (Optional)

A dry element air cleaner filters all of the air entering the engine. Excessive restriction of the air intake system affects horsepower, fuel consumption and engine life. Inspect the element at regular unit service intervals.



1.	Air Filter Box
2.	Air Filter
3.	Air Filter Cover

Dry Air Cleaner (Optional)

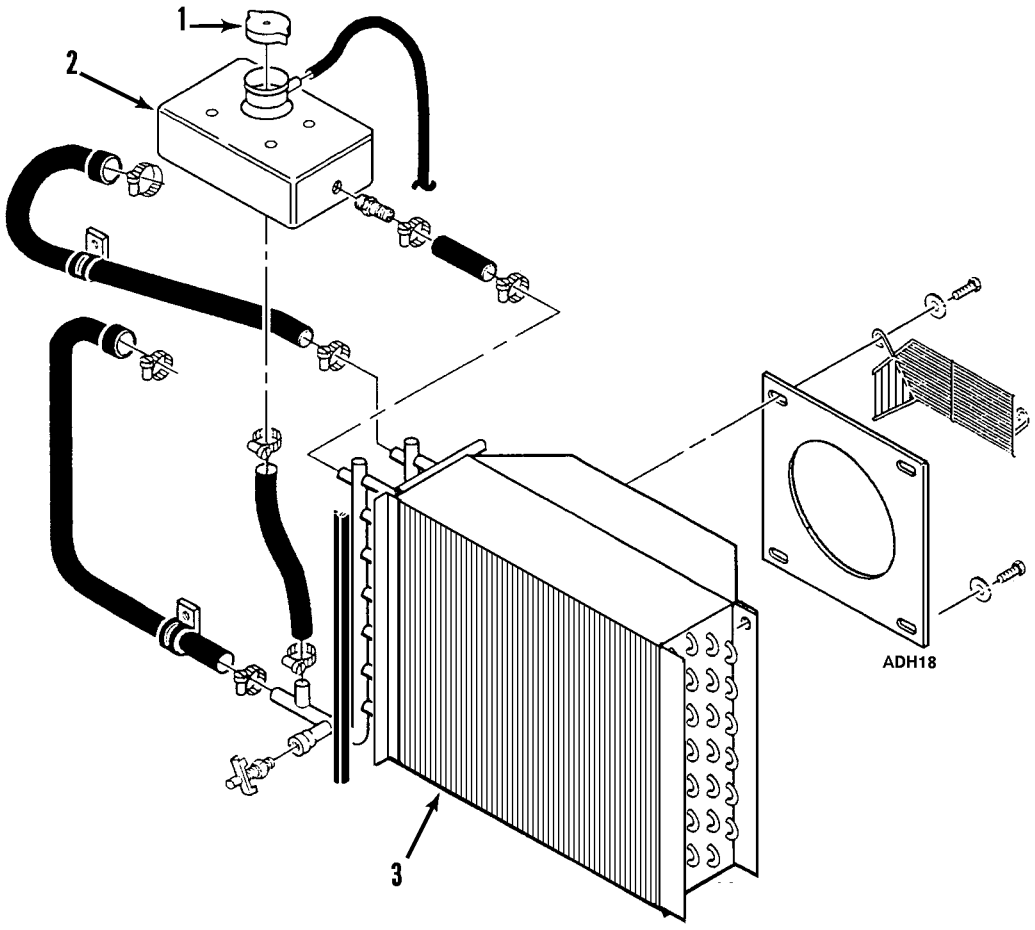
ENGINE COOLING SYSTEM

The engine employs a closed, circulating type, pressurized cooling system. Correct engine temperatures are controlled and maintained by a radiator, fan and thermostat. The coolant is circulated through the system by a belt-driven centrifugal pump. The pump draws the coolant from the side of the radiator (large header), circulates it through the cylinder block and head, then back to the radiator. A thermostat mounted in the water outlet from the cylinder head to the radiator automatically maintains coolant temperature within the specified temperature range.

All water-cooled engines are shipped from the factory with a 50% permanent type antifreeze concentrate and 50% water mixture in the engine cooling system.

This provides the following:

1. Prevents freezing down to -30 F (-34 C).
2. Retards rust and mineral scale that can cause engine overheating.
3. Retards corrosion (acid) that can attack accumulator tanks, water tubes, radiators and core plugs.
4. Provides lubrication for the water pump seal.



1.	Radiator Cap
2.	Expansion Tank
3.	Radiator

Engine Cooling System Components

Extended Life Coolant

Extended Life Coolant (ELC) has been phased in all truck and trailer units that are equipped with TK 486, TK 482, TK 3.95, TK 3.74, TK 2.40, and se 2.2 engines. A decal tag on the coolant expansion tank can identify units with ELC.

NOTE: The new engine coolant, Texaco Extended Life Coolant (ELC), is RED in color instead of the current GREEN colored coolants.

These are the Extended Life Coolants currently approved by Thermo-King for use in ELC units for five years or 12,000 hours.

- Texaco ELC #16445 (nitrite free) 100 % concentrate.
- Texaco ELC #16447 premixed 50/50 % concentrate.
- Havoline Dex-Cool #7994 (nitrite free) 100 % concentrate, or #7997 (with nitrites) 100 % concentrate.
- Havoline Dex-Cool #7995 (nitrite free) premixed 50/50 % concentrate.
- Shell Dexcool #94040.
- Shell Rotella #94041.
- Havoline XLC #30379 (Europe) 100 % concentrate.
- Havoline XLC #33013 (Europe) premixed 50/50 % concentrate.
- Saturn/General Motors Dex-Cool.
- Caterpillar ELC.
- Detroit Diesel POWERCOOL Plus.

CAUTION: The "Most Important Rules to Remember" are:

NEVER add "RED" Extended Life Coolants" to cooling systems using "GREEN" coolants.

NEVER add "GREEN" coolants to cooling systems using "RED" extended life coolants.

Antifreeze Maintenance Procedure

As with all equipment containing antifreeze, periodic inspection on a regular basis is required to verify the condition of the antifreeze. After one year of service, inhibitors become worn out and must be replace by changing the antifreeze.

Every year drain, flush, and replace the total antifreeze mixture to maintain total cooling system protection. When the antifreeze is replaced, use ethylene glycol type engine coolant concentrate meeting the GM 6038-M specification. The factory recommends the use of a 50/50 antifreeze mixture in all units even if they are not exposed to freezing temperatures. This antifreeze mixture will provide the required corrosion protection and lubrication for the water pump.

Checking the Antifreeze

Check the solution concentration by using a temperature compensated antifreeze hydrometer or a refactometer designed for testing antifreeze. Maintain a minimum of 50% permanent type antifreeze concentrate and 50% water solution to provide protection to -30 F (-34 C). Do not mix antifreeze stronger than 68% permanent type coolant concentrate and 32% water for use in extreme temperatures.

NOTE: The temperature range of antifreeze protection for units with the hot water heat (engine coolant) option is -34 to 50 F (-37 to -46 C).

Changing the Antifreeze

1. Run the engine until it is up to its normal operating temperature. Stop the unit.
2. Open the engine block drain and completely drain the coolant. Observe the coolant color. If the coolant is dirty, proceed with a, b and c. Otherwise go to 3.

CAUTION: Avoid direct contact with hot coolant.

   a. Run clear water into radiator and allow it to drain out of the block until it is clear.

b. Close the block drain and install a commercially available radiator and block flushing agent. Operate the unit in accordance with instructions of the flushing agent manufacturer.

c. Open the engine block drain to drain the water and flushing solution.

CAUTION: Avoid direct contact with hot coolant.

3. Run clear water into the radiator, and allow it to drain out of the block until it is clear.
4. Inspect all hoses for deterioration and hose clamp tightness. Replace if necessary.
5. Loosen the water pump belt. Check the water pump bearing for looseness.
6. Inspect the radiator cap. Replace the cap if the gasket shows any signs of deterioration.
7. Mix one gallon of permanent type antifreeze concentrate meeting GM 6038-M specification and one gallon clean water in a container to make a 50/50 mixture. (Do not add antifreeze and then water to the unit. This procedure may not give a true 50/50 mixture because the exact cooling system capacity may not always be known.)
8. Refill the radiator with the 50/50 antifreeze mixture and make sure to bleed the air from the cooling system.

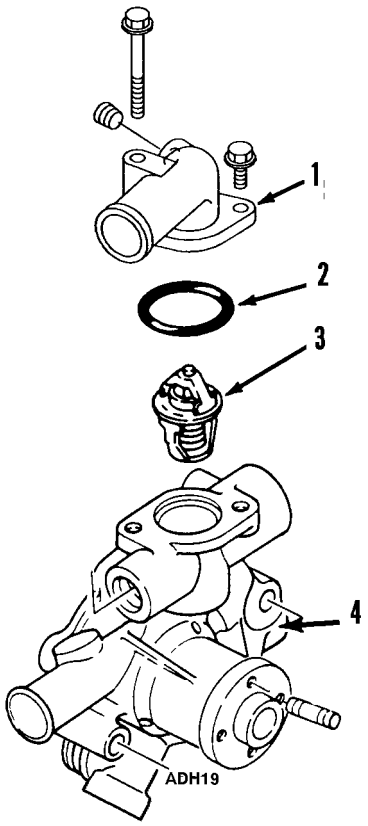
Bleeding Cooling System

After filling the radiator, run the unit up to operating temperature to check for overheating and to allow any air to be purged from the system. Check the coolant level and add coolant as necessary.

CAUTION: Do not remove radiator cap while engine is hot.

Engine Thermostat

For the best engine operation, use a 180 F (82 C) thermostat year around.



1.	Thermostat Housing
2.	Gasket
3.	Thermostat
4.	Water Pump

Water Pump Assembly and Thermostat

ENGINE FUEL SYSTEM

The fuel system used on the TK 2.49 diesel engine is a high pressure system used in conjunction with a prechamber.

The components of the fuel system are:

- fuel tank (may be the truck fuel tank)
- prefilter
- electric fuel pump
- fuel filter
- injection pump
- injection nozzles

A 10 psig (69 kPa) electric fuel pump pulls fuel from the fuel tank through a prefilter, then pushes it through the fuel filter to the injection pump. The prefilter is designed for diesel fuel and is the only type that should be used.

The injection pump plungers are activated by an extension on the engine camshaft. The governor sleeve and weight assembly is mounted on the end of the crankshaft with governor's speed requirements being relayed to the injection pump through a linkage arrangement located in the front timing cover. The injection pump raises the pressure of the fuel and meters the correct amount of fuel to the nozzle at the correct time. The increased fuel pressure will lift the spring loaded nozzle to admit fuel into the combustion chamber.

The fuel system is relatively trouble free and if properly maintained will usually not require major service repairs between engine overhauls.

The most common cause of fuel system problems is contamination. It cannot be stressed enough that the fuel must be clean, fuel tanks must be free from contaminants, and the fuel filter must be changed regularly. Any time that the fuel system is opened up, all possible precautions must be taken to keep dirt from entering the system. This means all fuel lines should be capped when open. The work should be done in a relatively clean area, if possible, and the work should be completed in the shortest time possible.

Thermo King recommends that any major injection pump or nozzle repairs be done by a quality diesel injection service specialty shop. The investment in equipment and facilities to service these components is quite high. Therefore, this equipment is not found in most repair shops.

The following procedures can be done under field conditions.

1. Bleeding air from the fuel system.
2. Maintenance involving the fuel tank and filter system.
3. Speed and governor adjustments.
4. Electric transfer pump replacement or repair (10 psig [69 kPa] pump with diesel filter).
5. Injection line replacement.
6. Pump timing.
7. Nozzle spray pattern testing and adjustment.
8. Minor rebuilding of nozzles.

Bleeding the Fuel System

If the engine runs out of fuel, if repairs are made to the fuel system, or if air gets into the system for any other reason, the air must be bled out of the fuel system.

NOTE: Make sure to keep the fuel tank vent open. If the vent becomes clogged, a partial vacuum develops in the tank, this may cause air to enter the system.

Proceed as follows:

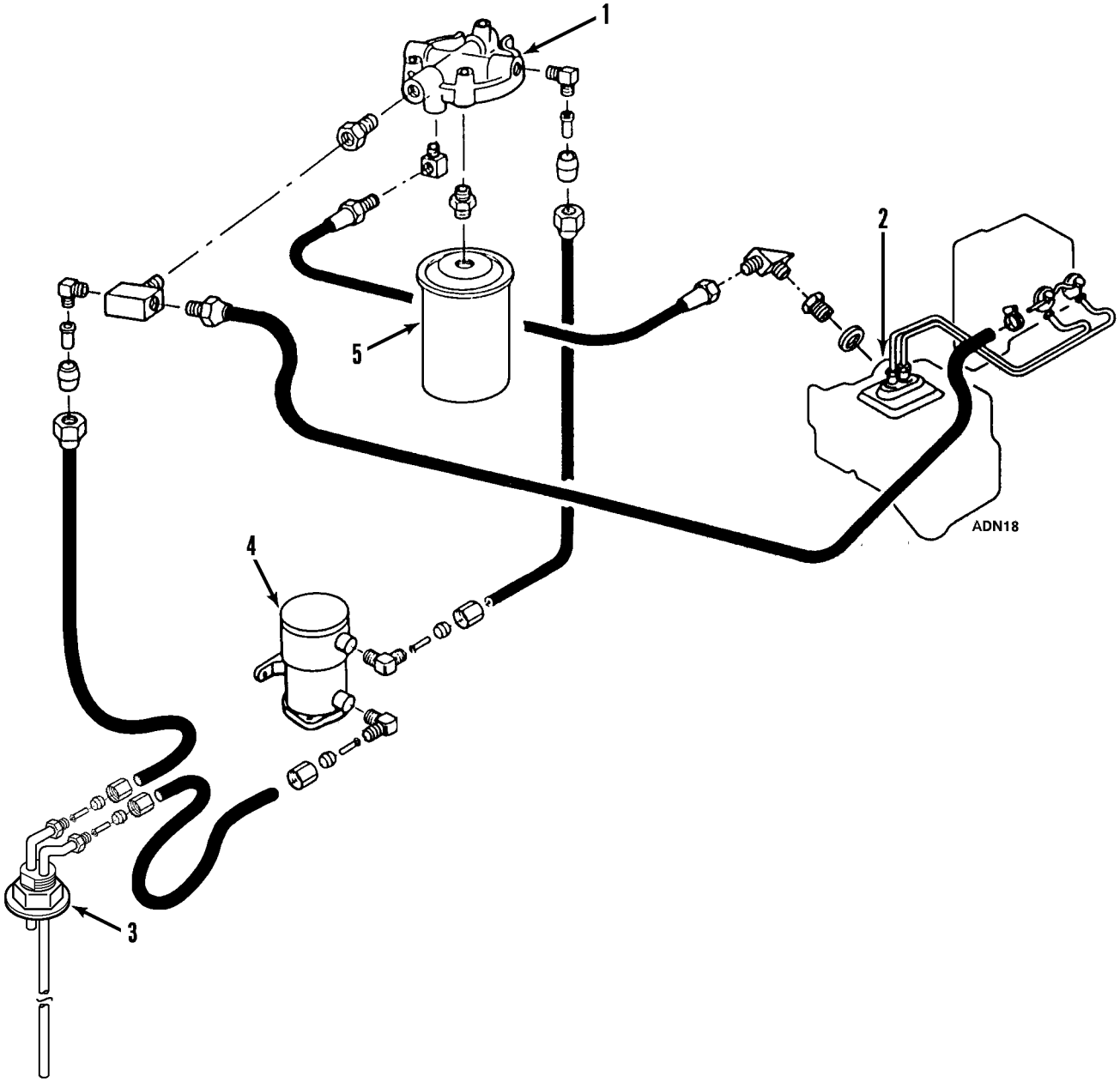
1. Loosen the air bleed screw in the inlet fuel fitting on the injection pump.
2. Turn on the electric fuel pump. The electric fuel pump is energized when the ON/OFF switch is turned ON. Tighten the air bleed screw when a clear flow of fuel appears.

   NOTE: For the initial start-up, crack the air bleed screw at the injection pump and bleed fuel until a clear flow of fuel is noted.
3. Loosen the injector lines at the injection nozzles.
4. Crank the engine until fuel appears at the nozzles. Tighten the injector lines, and start the engine.

   NOTE: Fuel will not appear at the nozzles by merely running the electric pump. The engine must be cranked.

Water in the Fuel System

Water in the fuel system can damage the injection pump and nozzles. This damage will subsequently cause more expensive damage to the engine. A large accumulation of water in the bottom of the fuel tank will stop a diesel engine. Water should be drained off periodically to avoid breakdowns. This should be done after the tank has set idle for an hour. DO NOT steam clean fuel tank caps.



1.	Filter Mounting Base
2.	Injection Pump
3.	Pick Up Tubes
4.	Prefilter
5.	Fuel Filter

Fuel System

Electric Fuel Pump

Operation

The electric fuel pump must be mounted next to the fuel tank. This pump is designed to push fuel rather than pull fuel.

Make sure the pump case has a good ground with the battery. The pump will not operate at less than 9 volts DC. The pump is self primping as long as it is not more than 30 in. (762 mm) above the fuel in the fuel tank.

Maintenance

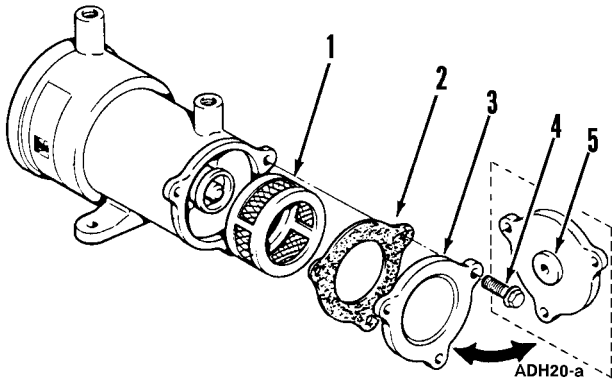
The fuel pump filter should be cleaned whenever the oil is changed. The filter and gasket are replaceable but the pump cannot be repaired, it must be replaced if it is defective.

Disassembly

1. Remove the three screws from the cover.
2. Remove the cover, gasket, and filter. Wash the filter in cleaning solvent and blow out the dirt and cleaning solvent with compressed air. Check the cover gasket and replace it if necessary. Clean the cover.

Assembly

Place the cover gasket on the cover, place the filter in the pump, install the cover and replace the three screws.



1.	Filter
2.	Gasket
3.	Cover
4.	Screw (3)
5.	Magnet

Electric Fuel Pump

If the pump does not operate, check for:

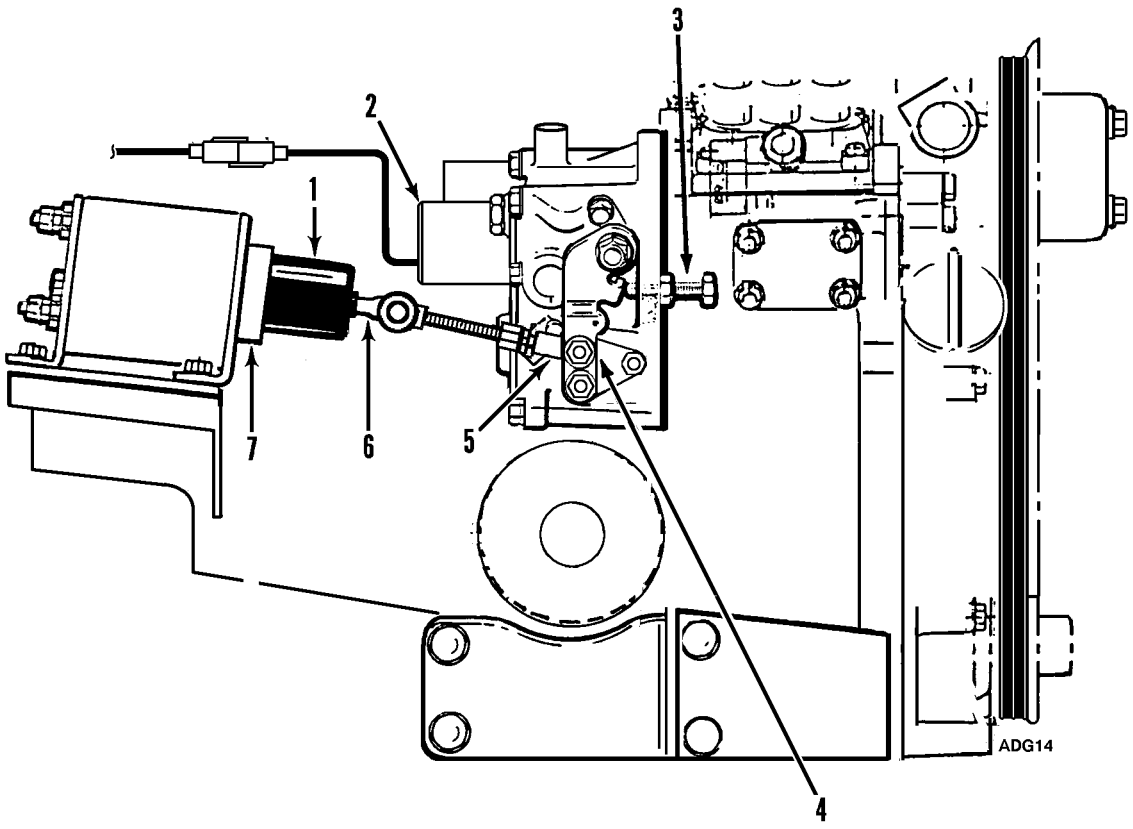
1. A good ground to the pump body.
2. Clean and tighten the electrical connections.
3. The pump voltage and polarity must be the same as the unit system.

If the pump operates but does not deliver fuel, check for:

1. Air leaks in the fuel lines or connections.
2. Kinks or other restrictions in the fuel lines.
3. A leaking or distorted cover gasket.
4. A clogged or dirty filter.

Integral Fuel Solenoid

The fuel stop solenoid is located on the end of the fuel injection pump.



1.	Bolt (P/N 91-3095)
2.	Fuel Stop Solenoid (P/N 41-1386)
3.	Low Speed Adjustment Screw
4.	Throttle Lever (P/N 11-6129)
5.	Ball Joint (11-8663)
6.	Eye Bolt (P/N 55-2762)
7.	Throttle Solenoid (P/N 44-9181)

Integral Fuel Solenoid Components

TK 2.49 ENGINE

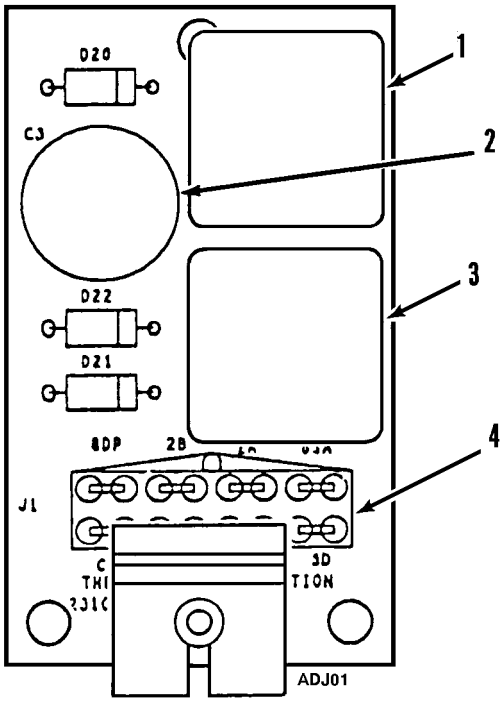
Operation of the TK 2.49 engine is controlled by the operation of the fuel solenoid and the throttle (high speed) solenoid. The fuel solenoid consists of a spring loaded plunger and electro-magnetic coil. When the engine is OFF, spring tension on the plunger maintains the plunger's "OUT" position. When pushed out, this causes the governor linkage to move the injection pump rack to the "FUEL OFF" position.

When the fuel solenoid is energized, current is applied to the coil creating an electro-magnetic field, which pulls the When in the "PULLED-IN" position, the plunger releases tension on the governor linkage. The governor linkage then moves the fuel injector rack, thus controlling the fuel flow and placing it in the "FUEL ON" position.

Adjustments made to the throttle (high) speed solenoid change governor spring tension which in turn adjust speed settings.

FUEL SOLENOID TIMERS ON PC BOARDS (TK 2.49 ENGINE)

The fuel solenoid timer is being used on CD-II MAX units, consists of a small PC board (P/N 41-1234) that contains a capacitor, three diodes, an eight pin wire connector, and two removable relays. It is used to provide a manual start relay. The manual start relay has been added to improve the starter reliability. This timer is mounted on the control box door to the right of the relay board.



1.	Fuel Solenoid Relay (FSR)
2.	Capacitor
3.	Manual Start Relay (MSR)
4.	Eight Pin Connector

New Fuel Solenoid Timer on PC Board

Electrical Changes

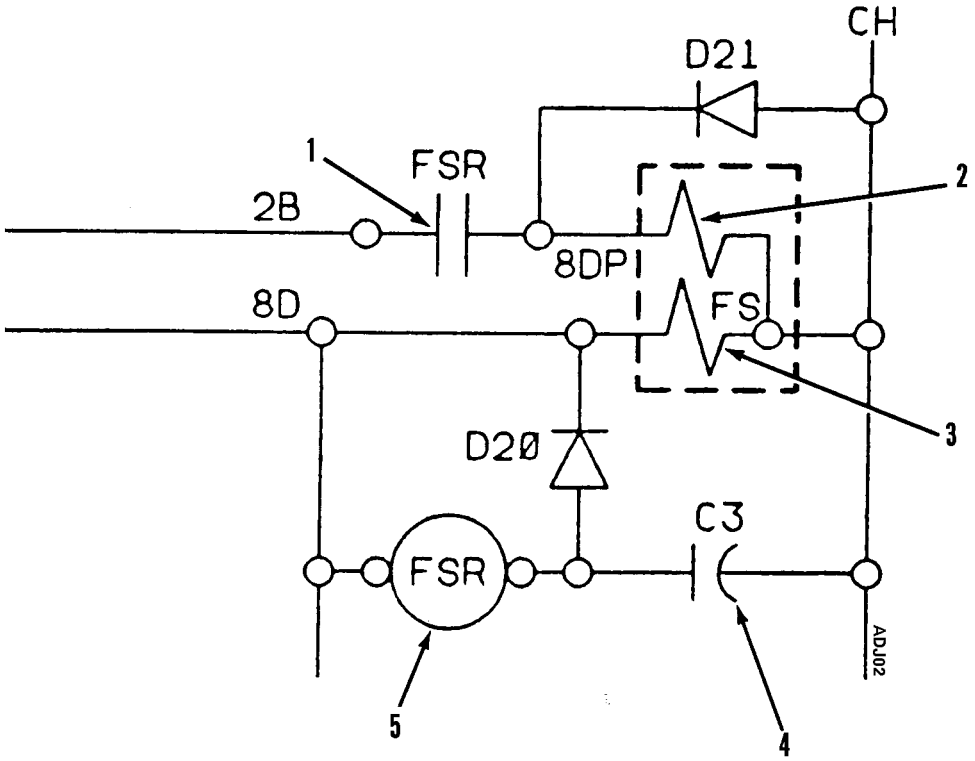
The fuel solenoid timer and fuel solenoid relay are located on a PC board. This improves reliability and simplifies the wiring.

The size of the capacitor has been changed to increase the pull-in time from 1 second to 2 seconds. This minimizes the chance that the pull-in coil would fail to open the fuel valve. The integral fuel solenoid contains two coils: the pull-in coil, and the hold-in coil. The pull-in coil draws approxi-

mately 30 to 40 amps at 12 volts. The hold-in coil draws approximately 1 amp at 12 volts.

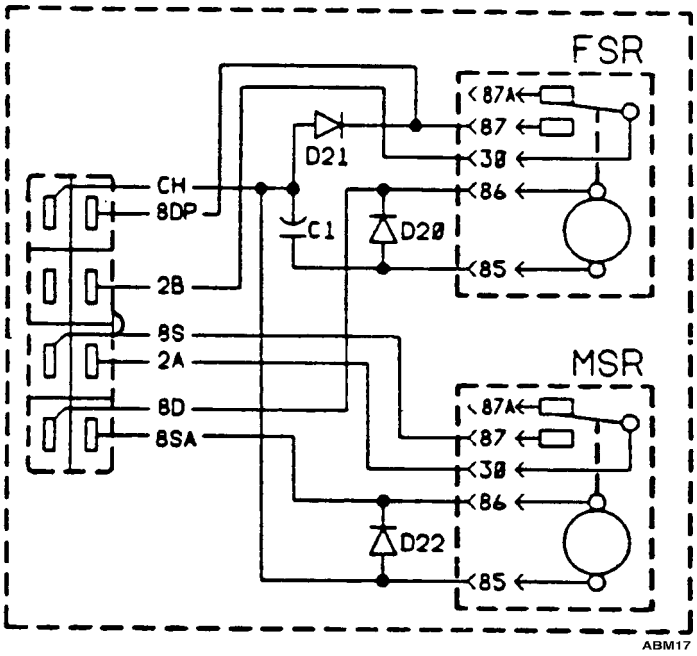
The pull-in coil must be energized to move the injection pump governor linkage to the fuel ON position. Once the injection pump governor linkage has been moved to the fuel on position, the hold-in coil will keep it in fuel on position until the 8D circuit is de-energized. The pull-in coil must be de-energized after the 2 second pull-time.

The timer now turns OFF instantly because the capacitor discharges through the hold-in coil in the fuel solenoid (8D circuit). This minimizes the chance that the timer would fail to energize the fuel solenoid relay after the unit had been turned off momentarily. The earlier timer required the unit to be turned off for at least 3 seconds to discharge the capacitor.



1.	Fuel Solenoid Relay Contacts
2.	Fuel Solenoid Pull-in Coil
3.	Fuel Solenoid Hold-in Coil
4.	Capacitor
5.	Fuel Solenoid Relay Coil

Simplified Schematic Diagram of Updated Integral Fuel Solenoid System



Wiring Diagram of P/N 41-1234 Fuel Solenoid Timer and Manual Start Relay PC Board

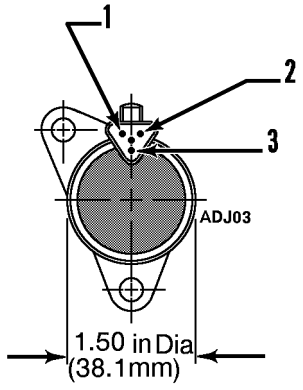
NOTE: The manual start relay has been added to improver the starter reliability.

Troubleshooting the Integral Fuel Solenoid System

NOTE: The fuel solenoid pull-in coil will require 35 to 45 amps to turn on the fuel. The unit's battery must be in good condition. If the battery has enough power to crank the engine over, it has enough power to energize the fuel solenoid pull-in coil.

If you suspect that the engine does not run because the fuel solenoid is not operating correctly, use the following procedure:

1. Disconnect the 20 wire from the RESET switch so the RESET switch will not trip.
2. Disconnect the 8S wire from the starter solenoid.
3. Disconnect the fuel solenoid wire connector from the fuel solenoid.
4. Turn the unit ON and check the voltage on the 8D pin in the fuel solenoid wire connector from the main wire harness. Refer to the following illustration to identify the pins in the wire connector and in the fuel solenoid.



1.	Hold Coil 8DP Color: White
2.	Pull Coil 8D Color: Red
3.	Common—Ground Color: Black CH

Fuel Solenoid Pin Identification

a. If battery voltage is not present on the 8D circuit, check the 8D circuit for an open or a short.

b. If battery voltage is present on the 8D circuit, go to step 5.

5. Check the CH pin in the fuel solenoid wire connector for continuity to a good chassis ground.

   a. If there is no continuity between the CH pin in the fuel solenoid wire connector and a good chassis ground, check the black (CH) wire that goes from the fuel solenoid connector to the CH terminal on the throttle solenoid for an open circuit.

   b. If this black (CH) wire is not open, check the other CH wire connected to the CH terminal on the throttle solenoid for an open circuit.

   c. If there is continuity between the CH pin in the fuel solenoid connector and a good chassis ground, go to step 6.

6. Place a jumper wire between the CH pin in the fuel solenoid and a good chassis ground.

7. Test the pull-in coil by momentarily placing a jumper between the 8DP pin in the fuel solenoid and the 2 terminal at the fuse link. The fuel solenoid should make a definite click when the pull-in coil is energized and should click again when the pull-in coil is de-energized.

   NOTE: The pull-in coil will draw 30 to 40 amps so do not leave the jumper connected to the 8DP pin for more than a few seconds.

   a. If the pull-in coil does not energize, check the resistance of the pull-in coil by placing an ohmmeter between the 8DP pin and the CH pin in the fuel solenoid. The resistance of the pull-in coil should be 0.4 to 0.3 ohms. If the resistance of the pull-in coil is not in this range, replace the fuel solenoid.

   NOTE: If the pull-in coil fails, make sure to replace the fuel solenoid relay with a Potter-Brumfield relay P/N 44-9111.

   b. If the pull-in coil does energize, go to step 8.

8. Test the hold-in coil.

   a. Energize the hold-in coil by placing a jumper between the 8D pin in the fuel solenoid and the 2 terminal at the fuse link.

   b. Momentarily energize the pull-in coil by placing a jumper between the 8DP pin in the fuel solenoid and the 2 terminal at the fuse link. The fuel solenoid should make a definite click when the pull-in coil is energized, but should not click when the pull-in coil is de-energized.

   c. De-energize the hold-in coil by removing the jumper from the 8D terminal. The fuel solenoid should make a definite click when the hold-in coil is de-energized.

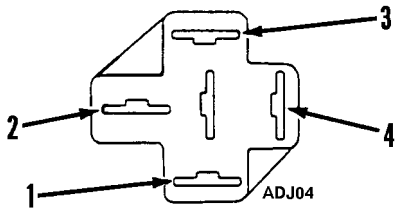
   d. If the hold-in coil does not function properly, check the resistance of the hold-in coil by placing an ohmmeter between the 8D pin and the CH pin in the fuel solenoid. The resistance of the hold-in coil should be approximately 12.8 ohms. If the resistance of the hold-in coil is not in this range, replace the fuel solenoid.

   e. If the hold-in coil does function properly, go to step 9.

9. Reconnect the fuel solenoid wire connector to the fuel solenoid.

10. Remove the fuel solenoid relay from its socket and make sure the unit is turned ON.

11. Check the voltage on the 8D circuit at the 85 terminal in the fuel solenoid relay socket. Refer to the following illustration to identify the terminals in the relay socket.
    a. If battery voltage is not present on the 8D circuit, check the 8D circuit for an open or a short (minimum voltage is 10 volts).
    b. If battery voltage is present on the 8D circuit, go to step 12.
12. Check the voltage on the 2B circuit at the 30 terminal in the fuel solenoid relay socket.
    a. If battery voltage is not present on the 2B circuit, check the 2B circuit for an open or a short.
    b. If battery voltage is present on the 2B circuit, go to step 13.
13. Test the relay.
    a. Use a jumper to connect the 85 terminal on the relay to the 2 terminal at the fuse link.
    b. Use another jumper to connect the 85 terminal on the relay to the 2 terminal at the fuse link.
    c. If the relay does not energize, it is defective. Replace the relay.
    d. If the relay does energize, the timer is defective. Replace the fuel solenoid timer PC board.
14. Remember to reconnect the 20 wire to the RESET switch.



1.	30 Terminal—2B Circuit
2.	86 Terminal to Capacitor and Diode
3.	85 Terminal—8D Circuit
4.	87 Terminal—8DP Circuit

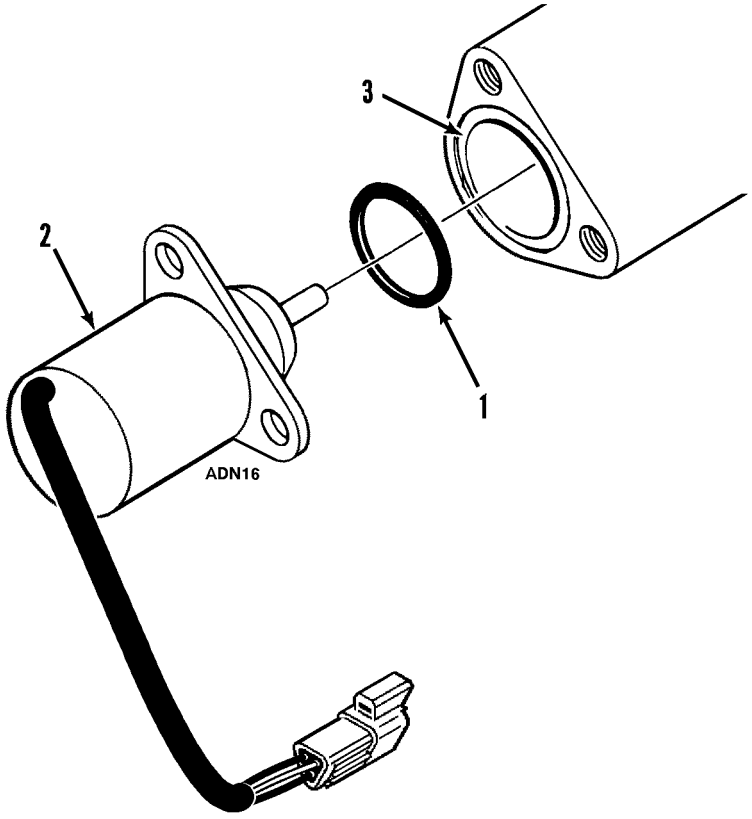
Relay Socket Terminal Identification

Fuel Solenoid Replacement

1. Disconnect the 20 wire from the reset switch to prevent the reset switch from tripping.
2. Disconnect the fuel solenoid wire connector and remove the old fuel solenoid.
3. Connect the fuel solenoid wire connector to the new fuel solenoid.
4. Turn the unit ON to energize the fuel solenoid.

NOTE: The fuel solenoid must be energized when it is being installed. If it is not, the plunger and the linkage may not line up correctly and the fuel solenoid will not function properly.

5. Place the O-ring in the groove in the end of the fuel injection pump. Make sure that the O-ring is positioned correctly during installation to avoid damage and leaks.
6. Install the new fuel solenoid.
7. Turn the unit OFF and make sure to connect the 20 wire to the RESET switch.

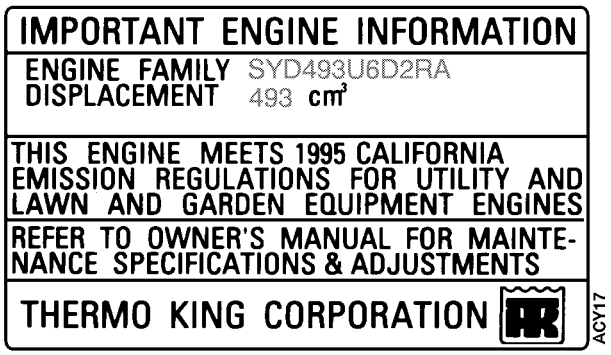


1.	O-Ring
2.	Fuel Stop Solenoid
3.	Fuel Injection Pump Groove

Fuel Solenoid Components

FUEL LIMIT SCREW

The fuel limit screw is not adjustable. It is equipped with an anti-tamper cap to fulfill requirements for CARB (California Air Resources Board) emission regulations. Service technicians must be CARB certified to perform service on fuel limit screw for equipment operating in California. All other equipment can be serviced per recent service bulletins with special tools and procedures. California service technicians should see your local Thermo King dealer for recent bulletins.



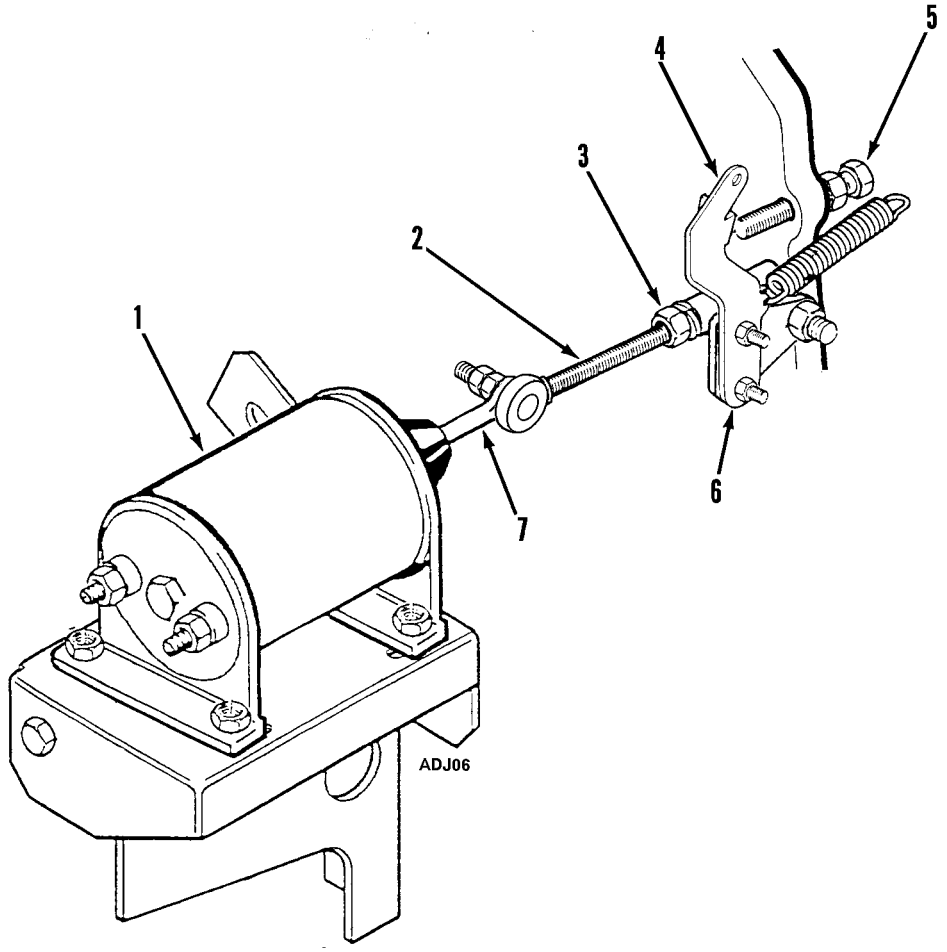
CARB Certification Decal

ENGINE SPEED ADJUSTMENTS

When the diesel engine fails to maintain the correct engine speeds, check the following before adjusting the speed:

1. Clean the fuel prefilter screen. Recheck the speed.
2. Bleed air out of the fuel system. Recheck the speed.
3. Bleed air out of the nozzles. Recheck the speed.
4. Check the operation of the electric fuel pump.

Make engine speed adjustments with the engine fully warmed up.



1.	Throttle Solenoid	5.	Low Speed Adjustment Screw
2.	Adjuster	6.	Throttle Lever
3.	Jam Nut	7.	Eye Bolt
4.	Regulator Handle		

Engine Speed Adjustments

Low Speed Adjustment

1. Start the unit and let it run until the engine is warmed up.
2. Set the thermostat to make the engine run in low speed and check the engine speed. The engine speed should be 1550 to 1650 rpm. If the engine speed is not correct, loosen the jam nut on the low speed adjustment screw.
3. Turn the low speed adjustment screw to change the engine speed. Turn the screw in to increase the engine speed. Turn the screw out to decrease the engine speed.
4. Set the engine speed at 1550 to 1650 rpm and tighten the jam nut.

High Speed Adjustment

1. Start the unit and let it run until the engine is warmed up.
2. Set the thermostat to make the engine run in high speed and check the engine speed. The engine speed should be 2350 to 2450 rpm.
3. If the engine speed is not correct, loosen the jam nuts at the ends of the adjuster.
4. Turn the adjuster to change the engine speed. Turn the adjuster clockwise to increase the engine speed. Turn the adjuster counterclockwise to decrease the engine speed.
5. Set the engine speed at 2350 to 2450 rpm and tighten the jam nuts.

Part Description	Part Number	Quantity
Fuel Stop Solenoid	41-1386	1
O-ring	33-2770	1
Throttle Solenoid	44-9181	1
Relay	44-9111	1

INJECTION PUMP REMOVAL, INSTALLATION AND TIMING

Injection Pump Removal

1. Remove the fuel injection lines and the fuel lines. Remove the four nuts holding the pump to the timing cover, and the fuel supply line.
2. Remove the inspection plate on the side of the timing cover.
3. Remove the clip that connects the rack pin to the governor arm.
4. Center the rack in the pump body, then remove the injection pump from the timing cover. The timing shims will usually stay attached to the pump.

CAUTION: If the rack is not positioned correctly, the pump will not come out of the timing cover.

Injection Pump Installation

1. Replace the shim set if it has been damaged during the pump removal. New shims are supplied in sets. Select a set with the same thickness as that removed from the pump.

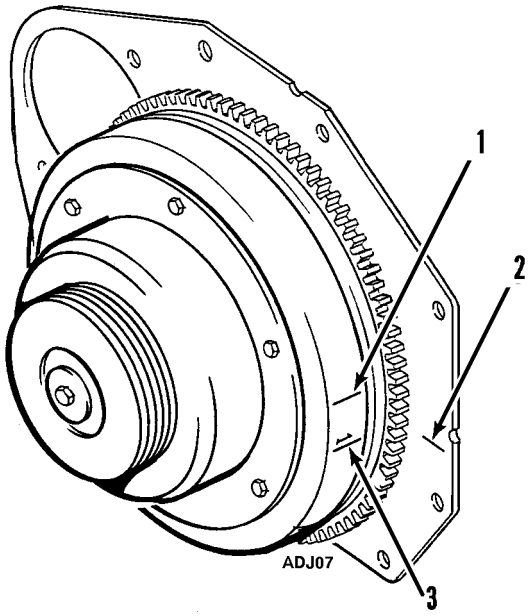
   NOTE: Do not put gasket sealer on the shim set or the pump until the injection pump timing has been checked. The shim set may have to be replaced with one of a different thickness.

2. Center the rack in the pump body and insert the pump into the timing gear cover. The rack pin must be aligned with the governor arm as the pump is being inserted.
3. Install the clip that fastens the rack pin to the governor arm.
4. Install the washers and nuts. Torque the nuts to 18 to 20 ft-in (24 to 27 N•m).
5. Install the injection lines and the fuel lines.

Timing the Injection Pump to the Engine

There are two different types of timing procedures used on the TK 2.49 engine. One procedure involves checking to make sure the cylinders are timed correctly to each other. The second procedure times the injection pump correctly to the engine. If the cylinders are not timed correctly to each other, it is of no value to time the injection pump to the engine because one of the two cylinders would be out of time. The individual plungers in the injection pump are timed to each other by the use of spacers in the pump plunger base. It is unlikely that an injection pump would change individual cylinder timing unless it had been through some type of repair process, but if all other possible problems with a rough running engine have been checked, and especially if the engine's injection pump has been replaced or repaired recently, it may be worthwhile to check the individual cylinder timing. Because the possibility of incorrect individual cylinder timing is so minimal, the procedure for timing the pump to the engine will be covered first. The procedure for individual cylinder timing is very similar to timing the injection pump so it will be covered last.

CAUTION: The cylinders on the engine are numbered from the flywheel end to the water pump end. The number 1 cylinder is next to the flywheel. The number 2 cylinder is next to the water pump. The timing marks on the flywheel match this numbering system.

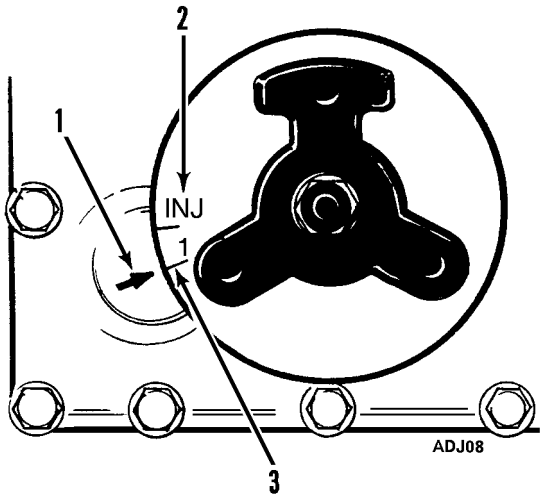


1.	Injection Mark
2.	Starter Plate Mark
3.	TDC Mark

Flywheel Timing Marks

NOTE: The top dead center timing marks are stamped on the flywheel and are identified by the cylinder number. The injection timing marks are also stamped on the flywheel but have no identifying numbers. The timing marks are 180° apart.

NOTE: The design of the CD-II MAX units makes it difficult to see the flywheel timing marks when the engine is mounted in the unit. Therefore, use the timing marks on the front engine pulley if necessary.



1.	Injection Mark
2.	Starter Plate Mark
3.	TDC Mark

Front Engine Pulley Timing Marks

1. Rotate the engine in the direction of rotation (clockwise as viewed from the water pump end) until the number 1 cylinder (closest to flywheel) is at approximately top dead center of the compression stroke. The valve cover should be removed to identify the compression stroke. Both rocker arms of the number 1 cylinder will be loose.
2. Remove the injection line from the number 1 injector and the injection pump. Remove the delivery valve holder, delivery valve and spring. Care must be taken to prevent dirt from entering the fuel injection system. Replace the delivery valve holder and the delivery valve.
3. Install a drip tube on the delivery valve holder.
4. Activate the run solenoid and the fuel pump by turning the unit ON. Make sure the DIESEL/ELECTRIC switch is in the DIESEL position.

CAUTION: Loosen the injection line at the injection nozzle for the number 2 cylinder to prevent any possibility of the engine firing.

5. The engine should be close to the top dead center position with the plunger port in the pump closed. No fuel should flow from the drip tube.
6. Turn the engine backwards past the injection timing mark until fuel flows from the drip tube.
7. Slowly rotate the engine in the direction of rotation while watching the drip tube. When the fuel flow slows to approximately one drip every 10 to 15 seconds, check the timing marks. They should be lined up.
8. If the timing marks did not line up, a shim or shims will have to be added or subtracted from the injection pump. Adding shims will retard the injection timing, subtracting shims will advance the timing. Increasing or decreasing shim thickness by 0.004 in. (0.1 mm) will change the timing by 1°.
9. After shims have been added or subtracted, recheck the timing.
10. When the injection pump has been correctly timed to the engine, remove the pump and put a light coat of silicone gasket sealer on the shim pack and the pump, or dip the new shims in lacquer thinner to activate the sealer.
11. Reinstall the pump, and torque the nuts to 18 to 20 ft-lb (24 to 27 N•m).
12. Reinstall the delivery valve spring. Torque the delivery valve holder to 30 ft-lb (41 N•m).
13. Reinstall the injection lines, bleed the air from the nozzles, and test run the engine.

Timing Individual Cylinder Injection

This procedure should be used when a poor running engine has had all possible problems checked but continues to run badly. If the injection pump has been repaired or replaced, the chance of individual cylinder timing problems has a greater possibility of occurring.

To check individual cylinder timing, follow the pump timing procedure but instead of changing shims to adjust the pump timing, check the timing of number 2 injector after checking number 1. Each cylinder should be timed to its respective flywheel timing marks.

If the injection pump plungers are not correctly timed to each other, the pump must be removed and sent to a diesel injection equipment repair shop for calibration.

ADJUST ENGINE VALVE CLEARANCE

1. Remove the valve cover. Torque the 18 mm diameter head bolts before adjusting valves: 26.8 ft-lb (36.3 N•m). The valve clearance should be checked after the first 500 hours of engine operation and then after every 2000 operating hours, maximum. It is very important that valves be adjusted to the correct specifications for satisfactory engine operation. Insufficient valve clearance will result in compression loss and misfiring of cylinders resulting in burned valves and seats. Excessive valve clearance will result in noisy valve operation and abnormal wear of the valves and rocker arms. The intake and exhaust valves are adjusted with the valves in the closed position.
2. Both the intake and the exhaust valve are adjusted to.008 in. (0.20 mm) with the temperature at 70 F (21 C).

   Rotate the engine in the direction of rotation, clockwise as viewed from the water pump end.

   CAUTION: Make sure fuel rack is OFF to prevent engine from starting.

   a. Turn the engine so the number 1 cylinder is on compression with the number 1 TDC mark aligned. Both number 1 push rods should turn freely. Adjust both valves on the number 1 cylinder.

   b. Turn the crankshaft 180° to align the TDC mark of the number 2 cylinder. Both number 2 push rods should turn freely. Adjust both valves on the number 2 cylinder.

      NOTE: In steps a and b if both push rods do not turn freely, rotate the engine 360° and check again.

   c. MAKE SURE to tighten the lock nut while holding the adjustment screw in position.
3. Install the valve cover and make sure that the gasket is in position.

BELTS

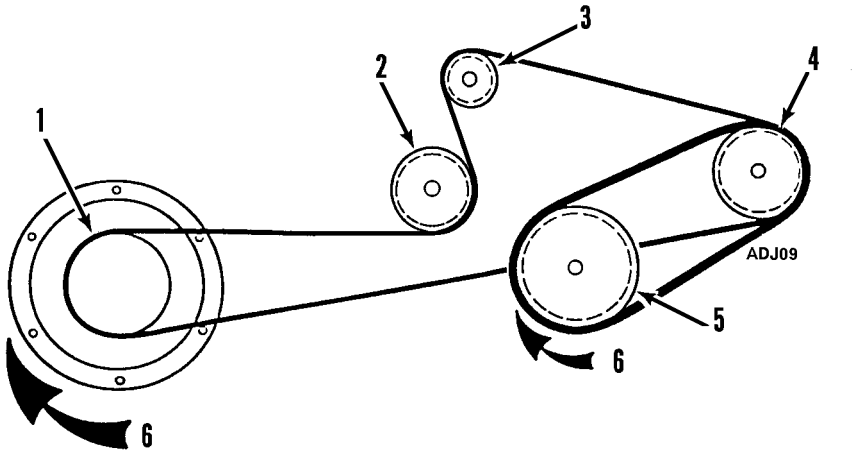
Belts should be regularly inspected during unit pre-trip for wear, scuffing or cracking and belt tension.

Belts that are too loose will whip, and belts that are too tight put too much strain on the belt fibers and bearings.

NOTE: Do not attempt to remove or install belts without loosening them. Belts that are installed by prying will fail prematurely due to internal cord damage.

CAUTION: Do not attempt to adjust belts with the unit running.

CAUTION: CYCLE-SENTRY equipped units—with the CYCLE-SENTRY switch in the AUTO START/STOP position and the ON/OFF switch in ON position, the unit may start at any time without prior warning. Switch the ON/OFF switch to the OFF position before performing maintenance or repair procedures.



1.	Engine/clutch
2.	Idler
3.	Alternator
4.	Motor/Jackshaft
5.	Compressor
6.	Rotation

Belt Arrangement

Motor/Jackshaft—Compressor Belt

NOTE: Adjust this belt before adjusting the Engine-Idler-Alternator-Motor/Jackshaft Belt.

1. Loosen the motor/jackshaft mounting bolts.
2. Position the motor/jackshaft to obtain a tension of 50 or 0.5 in. (13 mm) deflection at the center of the belt between the motor/ jackshaft and the compressor.
3. Tighten the mounting bolts.

Engine/Clutch-Idler-Alternator- Motor/ Jackshaft Belt

NOTE: Adjust the Engine/Clutch-Idler-Alternator-Motor/ Jackshaft Belt before adjusting this belt.

1. Loosen the alternator adjustment bolt and the pivot bolt.
2. Position the alternator to obtain a tension of 53.
3. Tighten the alternator adjustment bolt and the pivot bolt.

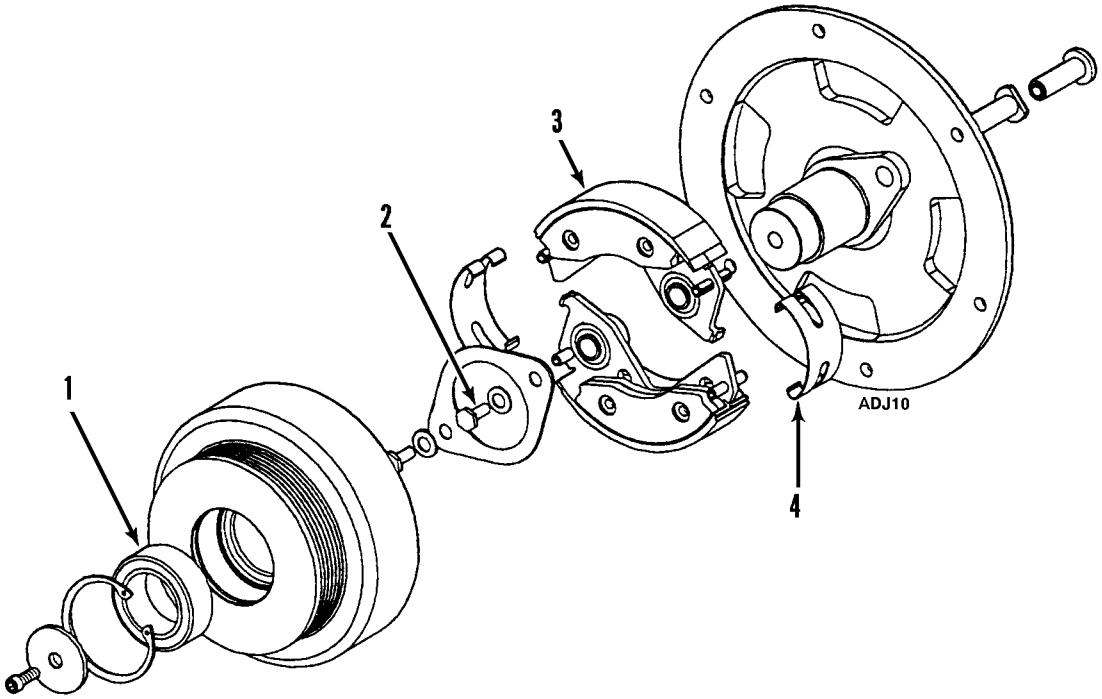
Water Pump Belt

Add or remove shims between the water pump pulley sheaves to obtain a tension of 40 or 0.5 in. (13 mm) deflection at the center of the belt between the crankshaft and the water pump.

CLUTCH

Clutch Maintenance

Inspect the clutch every 1,000 hours of operation or yearly, whichever occurs first. Remove the clutch, clean the shoes and drum, regrease the bearings or replace them if they are worn. Inspect the bushings, shoe shafts, shoe linings, and springs for wear and replace if necessary.



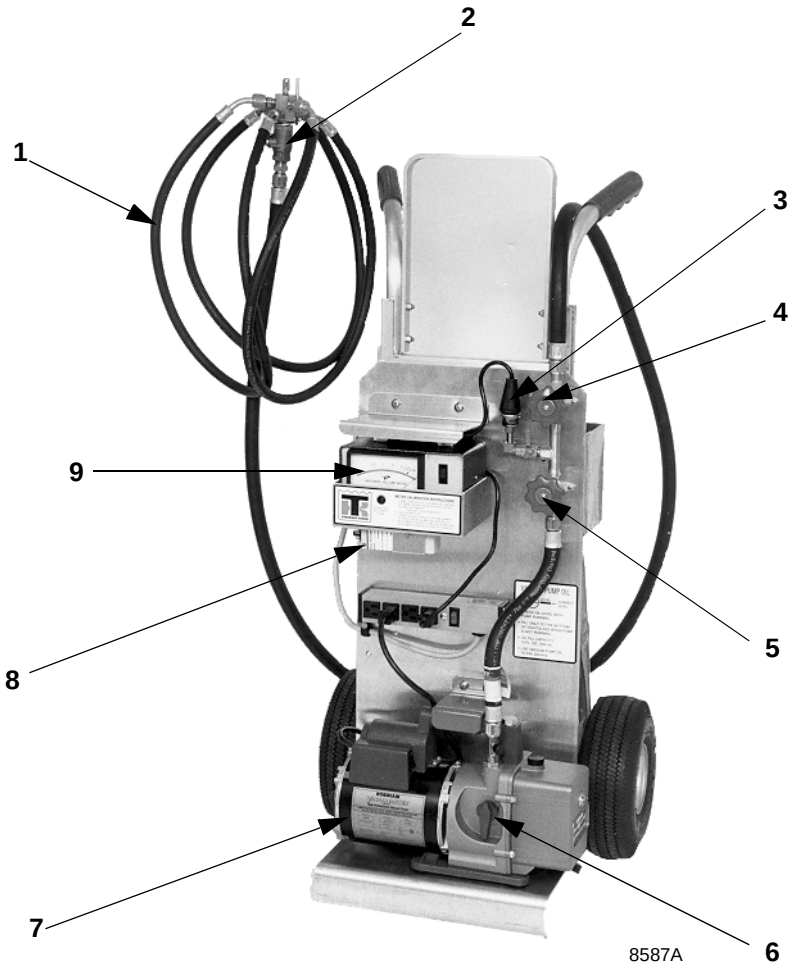
1.	Bearing
2.	Shoe Shaft
3.	Shoe
4.	Spring

Clutch

NOTE: The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by state and local laws.

All regulated refrigeration service procedures must be performed by an EPA certified technician, using approved equipment and complying with all Federal, state and local laws.

SYSTEM EVACUATION



1.	Evacuation Quality Hoses	6.	V-1
2.	V-4	7.	Two Stage Vacuum Pump
3.	Thermistor Sensor	8.	Calibration Standard
4.	V-3	9.	Micron Gauge
5.	V-2		

Evacuation Station—TK No. 204-725

Evacuation is Important and is Critical to System Performance!

NOTE: A low leak fitting must be used on hoses when Schrader port fittings are encountered on units (unit OFF).

It has been determined through testing and system analysis that refrigeration systems which contain non-condensable such as nitrogen and/or air can be overcharged with refrigerant when charged using the sight glass method. An overcharge of refrigerant will cause compressor damage.

Therefore, Thermo King recommends that all repairs to the refrigeration system include the removal and reclamation (cleaning) of the refrigerant, followed by a thorough evacuation using the proper tools and procedures. (See attached tool list and evacuation procedures.)

The primary objective of evacuation is to bring the system's pressure to a low micron level to ensure the removal of moisture and non-condensables. There are however, certain other principles which must be observed. These are:

- Evacuate from 3-points to access both sides of check valves and solenoids. Energize solenoids during evacuation to prevent trapping of refrigerant or non-condensables.
- Always leave service valve caps on during evacuation and do not exercise the valve stems while the unit is in a deep vacuum. Packing glands on older valves are prone to leak.
- Never attempt evacuation without a micron or vacuum gauge. The micron gauge will help determine:
  - If the pump is capable of pulling a deep vacuum.
  - When the vacuum pump oil is contaminated.
  - If the vacuum hoses and valves are leak free.
  - If the unit is leak free.
  - How long you should evacuate the unit.
  - That the unit is still in a deep vacuum before any lines are disconnected or refrigerant is added.

NOTE: The attached evacuation procedures have been written to be used with the Thermo King Evacuation System (Tool No. 204-725). However, the principles of 3-point evacuation and the use of a micron gauge during evacuation should always be practiced.

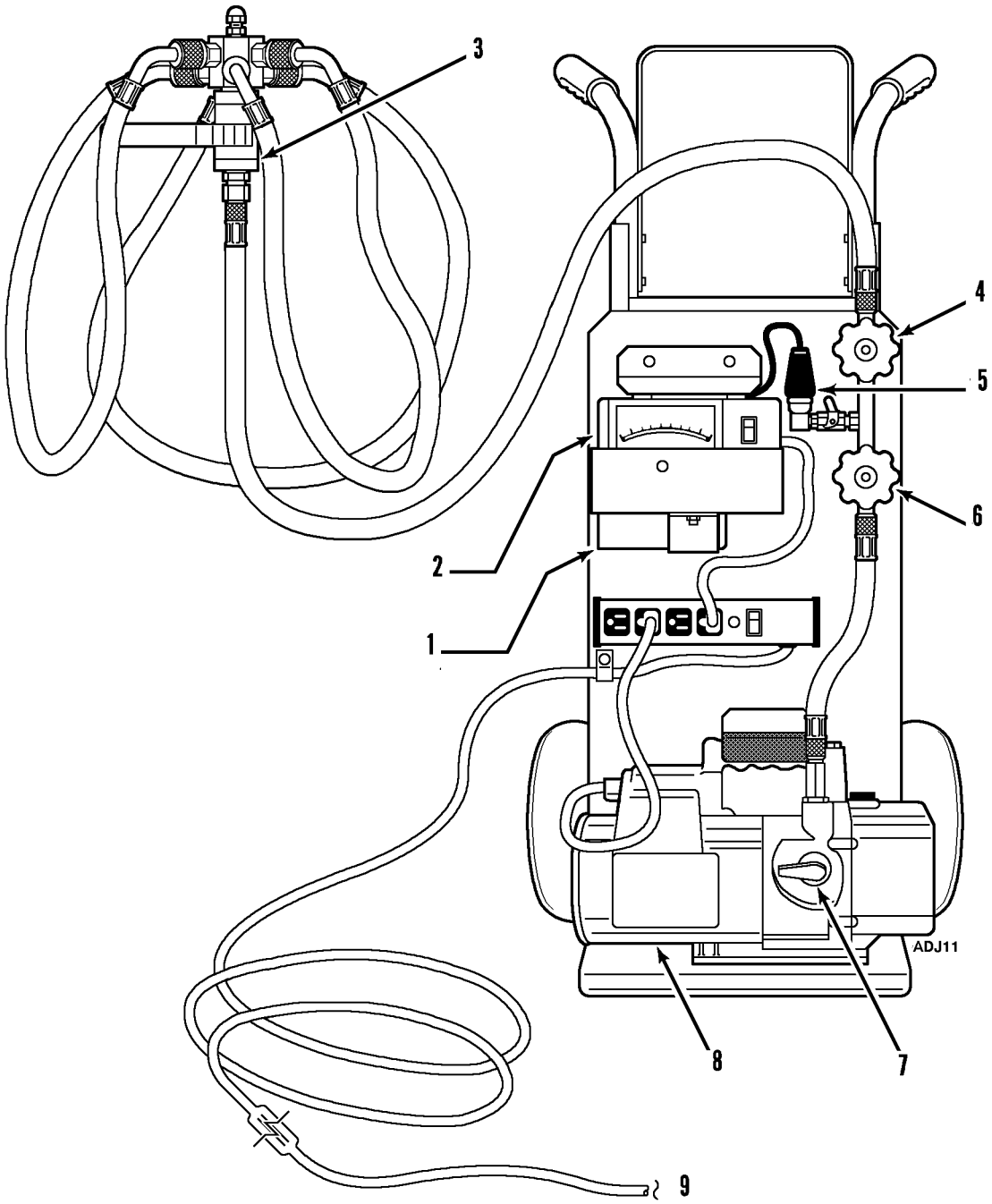
Refer to the diagram of the Thermo King evacuation station (Tool No. 204-725) and note the location of the valves.

Valve #1 (V-1): Is in the open position when the pump is running to evacuate the hoses and/or the unit. When V-1 is closed, the pump has been isolated from the hoses and/or the unit.

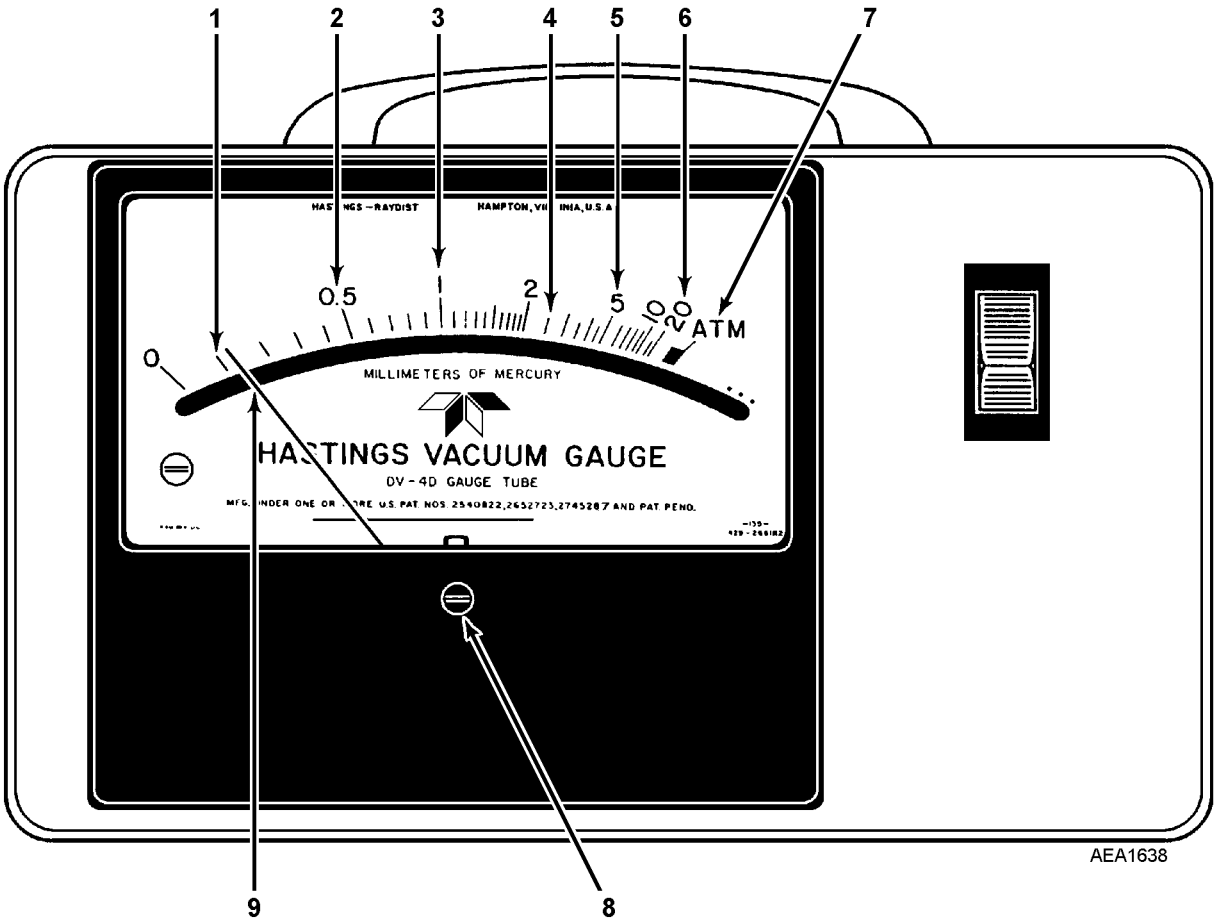
Valve #2 (V-2): Is in the open position during unit evacuation. In the closed position, V-2 isolates the micron gauge and thermistor assembly from the hoses and/or the unit.

Valve #3 (V-3): Is in the open position during unit evacuation. When closed, V-3 isolates the micron gauge and the vacuum pump from the other evacuation hoses.

Valve #4 (V-4): Is in the open position during unit evacuation. When closed, V-4 isolates the evacuation hoses and the unit from the evacuation system.



1.	Calibration Standard	6.	V-2
2.	Vacuum or Micron Gauge	7.	V-1
3.	V-4	8.	Two Stage Vacuum
4.	V-3	9.	P/N 204-725 (120 VAC); P/N 204-744 (220 VAC)
5.	Thermistor		



1.	100 Microns	6.	20000 Microns
2.	500 Microns	7.	Atmospheric Pressure
3.	1000 Microns	8.	Calibration Adjustment Screw
4.	2500 Microns	9.	Example: Meter needle shown at calibration position
5.	5000 Microns		when Calibration Standard specifices 0.15 mm Hg.

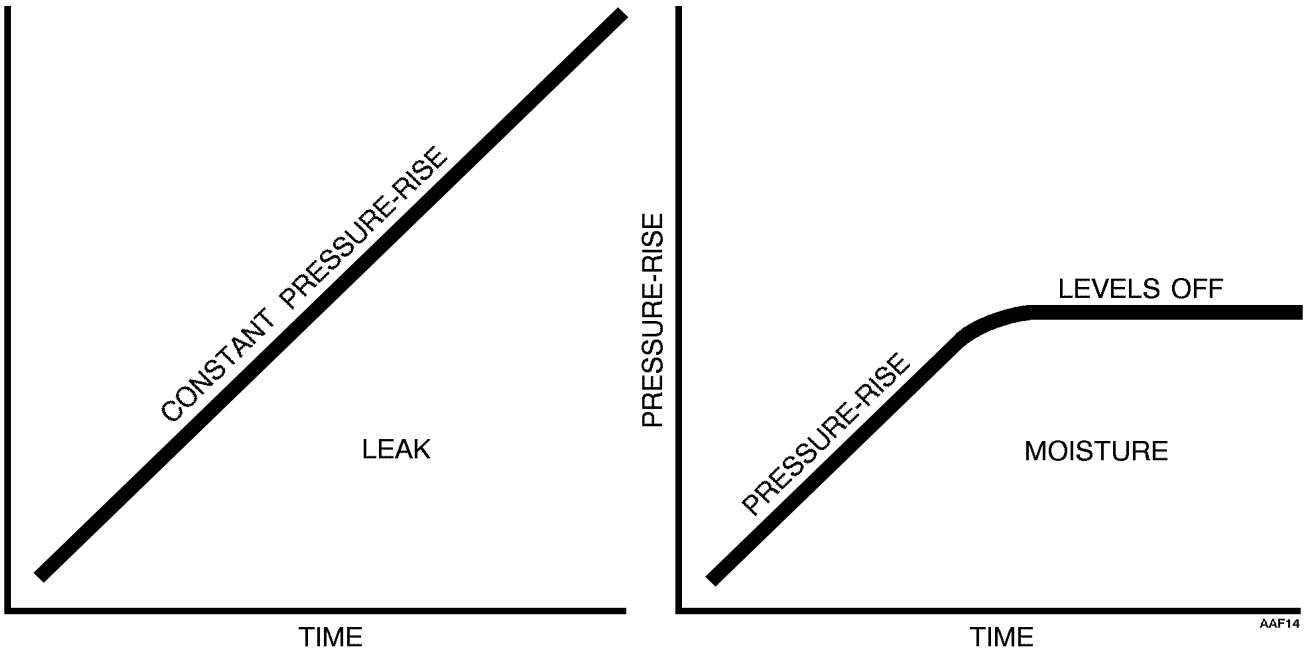
Set Up and Test of Evacuation Equipment

NOTE: Refer to the previous two pages for the following discussion.

1. Connect the evacuation system to a 110 Vac power supply. Connect a gauge manifold and refrigerant supply to the fitting above valve V-4. Turn the micron gauge ON.
2. Close valves V-1, V-3 and V-4. Valve V-2 is open.
3. Turn the vacuum pump ON.
4. Open valve V-1 at the pump. The micron gauge needle will move to the left. (Refer to micron gauge scale diagram—previous page.)

NOTE: If the vacuum pump is okay, and there are no leaks between V-1 and V-3, the micron gauge should show less than 500 microns. If not, locate and correct the problem.

5. With the pump still operating, open valve V-3. If the micron reading does not return to a level of less than 500 microns, locate and correct the problem before continuing.
6. With the vacuum pump still operating, open valve V-4. The micron level will rise momentarily. If the micron reading does not return to a level of less than 500 microns, locate and correct the problem before continuing.



LEAK

Isolate the pump from the system by closing the proper valve. Watch the movement of the vacuum gauge needle. If the needle continues to rise, this is an indication that a leak exists in the unit or the connecting line. The leak must then be located and eliminated.

MOISTURE

Should the needle show a pressure rise but finally level off to practically a constant mark, this is an indication that the system is vacuum tight but is still too wet, requiring additional dehydration and pumping time.

7. Evacuate hoses to 100 microns or lowest achievable level below 500 microns.

8. Once 100 microns is reached, close valve V-1 at the pump. Turn the vacuum pump OFF.

9. Observe the micron gauge reading. The vacuum rise should not exceed 1500 microns in 5 minutes.

10. If the rise is above 1500 microns in 5 minutes, check all hoses and connections for leaks. Hoses with moisture present will require additional evacuation time to achieve satisfactory results.

    NOTE: Dirty vacuum pump oil or a defective vacuum pump will prevent a low micron reading. Hoses and fittings can be isolated individually to identify leaks.

Unit Evacuation

NOTE: Refer to the diagram on page 154 for the following discussion.

NOTE: Do not attempt to evacuate the unit until the evacuation equipment has been tested and its performance has been verified.

1. Prepare the unit for evacuation. Recover refrigerant to 0 psig (0 kPa). (New Federal Regulations may require your recovery machine to pull the system's pressures lower than 0 psig [0 kPa]).

   CAUTION: Do not attempt to evacuate a unit until you are certain that the unit is leak free. A unit with less than a full refrigerant charge should be thoroughly leak checked and all leaks must be repaired.

2. Install hoses on the receiver tank, suction and discharge ports of the compressor.

3. Install a charging line from the spare access port on valve V-4 to a refrigerant supply bottle. Bottle valve closed.

4. Start the vacuum pump and open valves V-1, V-2, V-3 and V-4.

5. Evacuate the system to 500 microns or the lowest achievable level between 500 and 1000 microns.

   NOTE: The presence of refrigerant in the compressor oil may prevent a low micron reading from being achieved. The oil can continue to "outgas" for long periods of time. If the micron level appears to stall after 1/2 hour or 45 minutes between 1000 and 1500 microns, back seat the suction service valve and observe the micron gauge. A sharp drop in the micron reading (300 to 500 microns) would indicate that refrigerant is present in the oil or a leak exists in the compressor area.

6. When the desired micron level has been achieved (500 to 1000 microns), close valve V-1 at the pump. Turn the pump to OFF.

7. Observe the reading on the micron gauge after 5 minutes have elapsed. The vacuum rise should not exceed 2000 microns. If the vacuum level exceeds 2000 microns after 5 minutes, a leak is present or additional evacuation time is required.

8. If the vacuum level is acceptable, start the pump and open valve V-1 to evacuate the pressure rise (5 minutes).

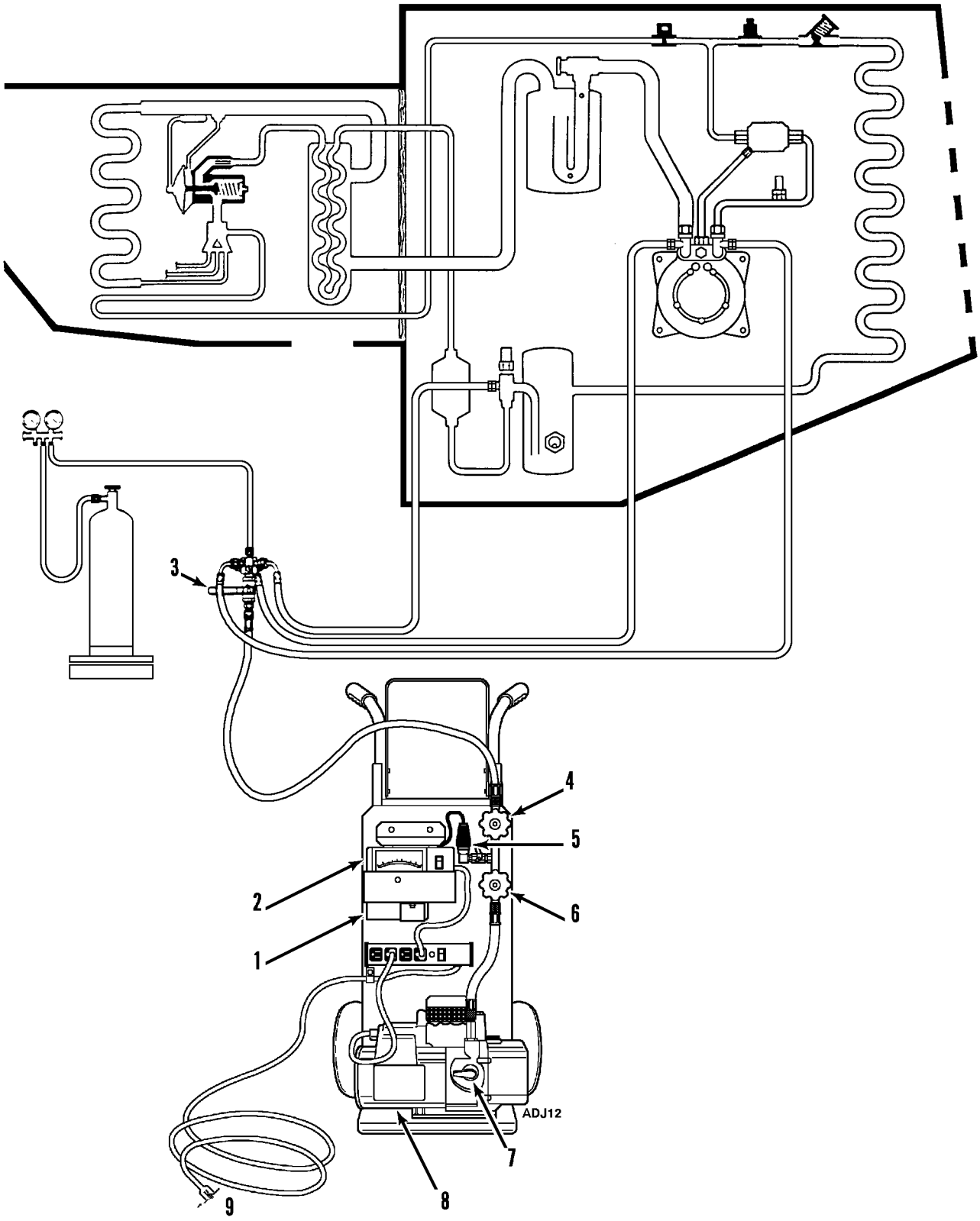
9. Close valve V-1 and stop the pump. Observe the micron gauge to confirm that the system remains in a deep vacuum. Close valve V-4. The unit is ready to charge.

Unit Charging

NOTE: Refer to the diagram on the next page for the following discussion.

NOTE: Before charging, make sure that the refrigerant lines from the gauge manifold to the refrigerant supply bottle have been evacuated or purged.

1. Valve V-4 is closed.
2. Set the refrigerant supply bottle for liquid. Open the gauge manifold hand valve, and charge liquid refrigerant until the system has the proper charge or until the system will take no more liquid.
3. After the liquid refrigerant is added, close the gauge manifold hand valve. Close the valve on the refrigerant supply bottle.
4. Back seat (close) the receiver outlet valve. Remove the evacuation station hoses.
5. If the unit is not fully charged, install a gauge manifold set on the suction and discharge ports of the compressor.
6. Open the refrigerant supply valve for liquid. Open the gauge manifold hand valve (suction side).
7. Start and operate the unit with the thermostat set for cool. Add liquid through the suction service port until the correct charge is attained. Make sure that the liquid level does not rise above the sight glass. Refer to the unit serial plate for the correct amount of charge.
8. When the correct amount of charge has been added, close the gauge manifold hand valve.



1.	Calibration Standard	6.	V-3
2.	Vacuum or Micron Gauge	7.	V-1
3.	V-4	8.	Two Stage Vacuum Pump
4.	V-2	9.	P/N 204-725 (120 VAC); P/N 204-744 (220 VAC)
5.	Thermistor		

Remove Evacuation Hoses

1. Gauge lines need to have low leak fittings.
2. Remove gauge lines.
3. Replace and tighten the valve stem caps.
4. The unit is ready for a functional check out.

REFRIGERANT LEAKS

Use a reliable leak detector (e.g., electronic detector) to leak test the refrigeration system. Inspect for signs of oil leakage which is the first sign of a leak in the refrigeration system.

NOTE: It is normal for compressor shaft seals to have a slightly oily film.

REFRIGERANT CHARGE

Testing the Refrigerant Charge with an Empty Box

If the unit has an insufficient charge of refrigerant, the evaporator will be "starved" and the box temperature will rise even though the unit is operating. The suction pressure will drop as the refrigerant charge decreases. The charge may be determined by inspection of the refrigeration through the receiver tank sight glass with the following conditions established:

1. Place a test box over the evaporator.
2. Place a thermometer (TK No. 204-135) test lead in the box near the evaporator return air opening.
3. Install the gauge manifold.
4. Run the unit on Cool until the air in the box indicates 0 F (-18 C). By allowing the box to leak a small amount, you will be able to maintain 0 F (-18 C).
5. **R-404A Systems**—The discharge or head pressure gauge should read 275 psig (1896 kPa).

   If the pressure is below this, it can be raised by covering a portion of the condenser coil with a piece of cardboard.
6. **R-404A Systems**—The compound gauge should be indicating 13 to 18 psig (90 to 124 kPa) gauge pressure.

   If there is any doubt about the unit gauge, check the calibration.
7. Under these conditions, the ball in the receiver tank sight glass should be floating.

Testing the Refrigerant Charge with a Loaded Box

1. Install a gauge manifold (optional).
2. Run the unit on the Cool cycle.
3. Cover at least three quarters of the condenser to drive any excess refrigerant from the condenser into the receiver tank.
4. As the head pressure is rising, check the receiver tank sight glass. The ball should be floating. If there is no indication of refrigerant in the receiver tank sight glass, the unit is low on refrigerant.

HIGH PRESSURE CUTOUT SWITCH (HPCO)

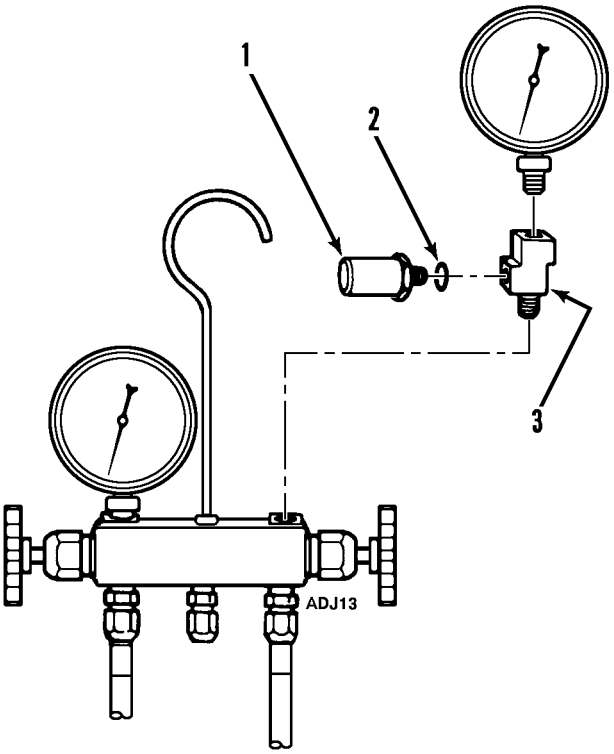
The HPCO is located in the compressor discharge line. If the discharge pressure rises above 470 psig (3241 kPa) for R-404A units, the HPCO opens the 8 circuit, de-energizing the fuel solenoid or the motor contactor. To test the HPCO, rework a gauge manifold per the High Pressure Cutout Manifold illustration.

1. Connect the gauge manifold to the compressor discharge service valve with a heavy duty, black jacketed, thick wall #HCA 144 hose with a 900 psig (6204 kPa) working pressure rating.

2. Set the thermostat well below the box temperature and run the unit in high speed cool.
3. Raise the discharge pressure of the compressor first by blocking the condenser coil air flow by covering the condenser grille with a piece of cardboard. If this does not raise the discharge pressure to the cutout level of the HPCO, increase the engine speed by overriding the throttle solenoid. This should increase the discharge pressure enough to cause the HPCO to cut out.

   NOTE: The discharge pressure should never be allowed to exceed a pressure of 470 psig (3241 kPa) on R-404A units.

4. Failure of the HPCO system to stop compressor operation should be investigated first by checking the control circuit operation and secondly by HPCO replacement.



1.	Relief Valve (66-6543)
2.	O-Ring (33-1015)
3.	Adapter Tee Weather Head (NO. 552X3)

High Pressure Cutout Manifold

LIQUID LINE SOLENOID (LLS)

The LLS is a normally open solenoid that closes when the unit shifts to heat. If the LLS fails and sticks in the closed position, the HPCO will shut down the unit whenever it shifts to cool. If the LLS fails and sticks in the open position or if it leaks, the unit will appear to operate normally.

HOT GAS SOLENOID (HGS)

The HGS is a normally closed solenoid that opens when the unit shifts to heat. If the HGS fails and sticks in the closed position, the HPCO will shut down the unit whenever it shifts to heat. If the HGS fails and sticks in the open position or if it leaks, the unit will not cool well and the suction pressure will be high.

NOTE: It is generally good practice to replace the filter drier whenever the high side is opened or when the low side is opened for an extended period of time.

LOW SIDE PUMP DOWN

NOTE: Operate all units in cool for 2 to 5 minutes with the service valves in their normal operating positions before performing the low side pump down. Install a gauge manifold at the compressor.

1. Run the unit in cool, front seat the receiver tank outlet valve, and pump down the low side to a 20 to 25 in. Hg vacuum (-68 to -85 kPa). Turn the ON/OFF switch OFF.

   If the unit pumps down acceptably and then holds at least a 15 in. Hg vacuum (-51 kPa) for 2 minutes or more, it can be assumed that the receiver tank outlet valve, the compressor discharge valve plates, and the HGS solenoid are sealing acceptably.

2. Prepare to perform service on the low side by equalizing the high side and low side pressures. Turn the ON/OFF switch ON and set the thermostat to shift the unit into heat. The gauge manifold's HIGH PRESSURE gauge will indicate a pressure decrease and the LOW PRESSURE gauge will indicate a pressure increase when the HGS opens.

   NOTE: Repeat the pump down procedure if the pressures equalize above 20 psig (138 kPa). If acceptably low pressures cannot be achieved after the third pump down, the refrigerant must be recovered to perform service on the low side.

   If the reading on the gauge manifold's HIGH PRESSURE gauge increases after the high and low side pressures have been equalized, the condenser inlet check valve is leaking.

ACCUMULATOR

Removal

1. Remove the refrigerant from the unit.
2. Unsolder the inlet and outlet suction lines from the accumulator tank.
3. Unbolt and remove the accumulator from the unit.

Installation

1. Place the accumulator in the unit and tighten the mounting bolts.
2. Solder the inlet and outlet suction lines to the accumulator tank.
3. Pressurize the low side and test for refrigerant leaks. If no leaks are found, evacuate the low side.
4. Evacuate the unit. Recharge with refrigerant.

COMPRESSOR

Removal

1. Remove refrigerant from the unit.
2. Loosen and remove the belts from the compressor pulley.
3. Disconnect the discharge and suction lines from the compressor.
4. Remove the compressor mounting bolts.
5. Lift the compressor out of the unit. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.

NOTE: When the compressor is removed from the unit, the oil level should be noted, or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the replacement compressor in the unit.

Installation

1. Lift the compressor into the unit and install the mounting bolts.
2. Install the discharge and suction lines.
3. Pressurize the system and test for refrigerant leaks. If no leaks are found, evacuate the system.
4. Replace the belts and adjust the tension.
5. Evacuate and recharge the unit.

CONDENSER/RADIATOR COIL

Removal

1. Remove the refrigerant charge.
2. Remove the grille assembly.
3. Drain engine coolant and disconnect the coolant hoses from the condenser/radiator coil.
4. Unsolder the inlet line and liquid line connections.
5. Unbolt and remove the condenser/radiator coil.

Installation

1. Clean the tubes for soldering.
2. Place the condenser/radiator coil in the unit and install the mounting hardware.
3. Solder the inlet line and liquid line connections.
4. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
5. Connect the coolant hoses to radiator and refill the cooling system tank with 50/50 ethylene glycol/water solution.
6. Recharge the unit with refrigerant.
7. Reinstall the front grille.

DRIER

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Disconnect the ORS nuts at the ends of the drier.
3. Loosen the mounting hardware and remove the drier.

Installation

1. Place new O-rings in the ORS fittings on the ends of the drier.
2. Install the new drier and tighten the mounting screws and nuts.
3. Install and tighten the inlet ORS nut. Hold the drier with a back-up wrench on the hex behind the ORS fitting.
4. Release a small amount of refrigerant to purge the air through the drier. Then tighten the outlet ORS nut.
5. Pressurize the system and inspect for leaks. If no leaks are found, open the refrigeration valves and place the unit in operation.

EVAPORATOR COIL

Removal

1. Pump down the low side and equalize the pressure to slightly positive.

2. Remove the evaporator panels.
3. Unsolder the expansion valve from the distributor.
4. Unsolder the suction line and hot gas line from the evaporator coil.
5. Remove the DEFROST TERMINATION switch.
6. Disconnect the electric heaters and the HIGH TEMPERATURE switch or remote temperature sensor (if so equipped).
7. Remove the mounting bolts and slide the coil from the evaporator housing.

Installation

1. Place the evaporator coil in the housing.
2. Install and tighten the mounting bolts.
3. Clean the tubes for soldering.
4. Solder the suction line and drain pan hot gas line connections to the evaporator coil.
5. Install the DEFROST TERMINATION switch.
6. Solder the distributor to the expansion valve assembly.
7. Connect the HIGH TEMPERATURE SWITCH or remote temperature sensor and electric heaters (if so equipped).
8. Pressurize the low side and test for leaks. If not leaks are found, evacuate the low side.
9. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and add as required.

EXPANSION VALVE ASSEMBLY

Removal

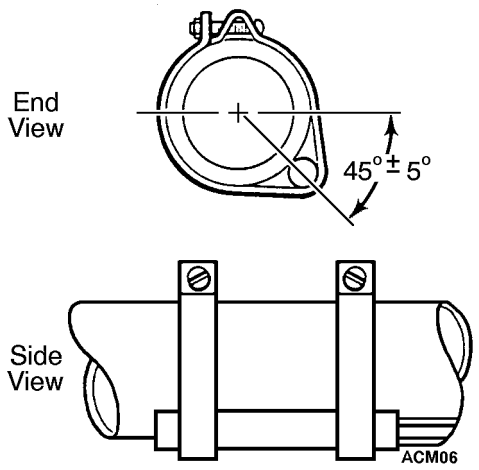
1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove feeler bulb from suction line clamp. Note the position of the feeler bulb on the suction line.
3. Unsolder the equalizer line from the expansion valve.
4. Unsolder the inlet liquid line and the distributor from the expansion valve.
5. Remove the expansion valve mounting bolt and remove the expansion valve from the unit.

Installation

1. Install and bolt the expansion valve assembly in the unit.
2. Solder the inlet liquid line and distributor to the expansion valve.
3. Solder the equalizer line to the expansion valve.
4. Clean the suction line to a bright polished condition. Install the feeler bulb clamps and the feeler bulb on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or the operation will be faulty. Wrap the feeler bulb with insulating tape.
5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
6. Open the refrigeration valves and place the unit in operation.

EXPANSION VALVE ASSEMBLY (continued)

7. Test the unit to see that the expansion valve is properly installed.



Location of Expansion Valve Bulb

HEAT EXCHANGER

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator panels.
3. Remove the mounting bolts that hold the heat exchanger on the bulkhead.
4. Unsolder the refrigeration lines.
5. Lift the heat exchanger assembly out of the evaporator housing.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the evaporator housing and install the mounting hardware loosely.
3. Solder the refrigeration lines and tighten the mounting hardware.
4. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
5. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

HIGH PRESSURE CUTOUT SWITCH

Removal

1. Pump down the low side and equalize the pressure in the high side to slightly positive.
2. Disconnect the wires and remove the HIGH PRESSURE CUTOUT switch from the discharge line.

Installation

1. Apply a refrigerant locktite to the threads of the high pressure cutout switch.
2. Install and tighten the high pressure cutout switch and reconnect the wires.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, open the refrigeration valves and place the unit in operation.

HIGH PRESSURE RELIEF VALVE

Removal

1. Remove the refrigerant charge.
2. Remove the high pressure relief valve.

Installation

1. Apply a refrigerant oil to the O-ring on the high pressure relief valve.
2. Install and tighten the high pressure relief valve.
3. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
4. Recharge the unit with refrigerant.

SUCTION PRESSURE REGULATOR VALVE

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the remaining pressure and unsolder the suction pressure regulator valve from the accumulator tank and suction tube.

Installation

1. Clean the tubes for soldering.
2. Place the valve in position and solder the connections.
3. Pressurize the low side and check for leaks.
4. If no leaks are found, evacuate the low side.
5. Open the refrigeration valves, and place the unit in operation. Check the refrigerant charge and add refrigerant as required.

RECEIVER TANK

Removal

1. Remove the refrigerant charge.
2. Unsolder the inlet tube from the receiver tank.
3. Unsolder the drier line from the receiver tank outlet tube.
4. Unbolt the mounting hardware and remove the receiver tank from the unit.

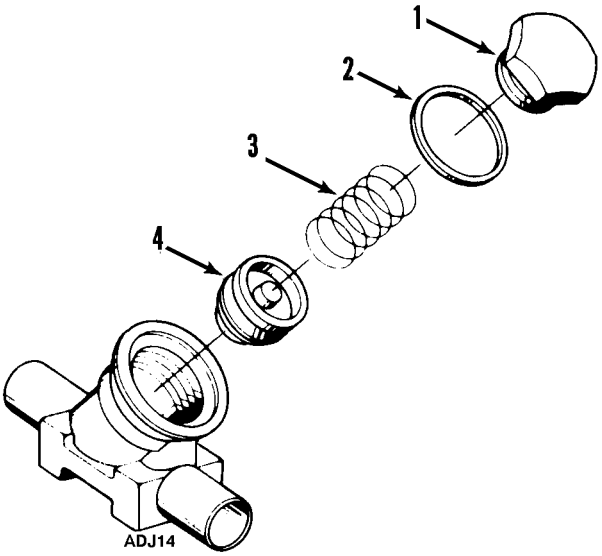
Installation

1. Place the receiver tank in the unit and install the mounting hardware loosely. Position the receiver tank so the sight glass is clearly visible and the outlet tube lines up with the drier line.
2. Solder the inlet tube to the receive tank.
3. Solder the drier line to the receiver tank outlet tube.
4. Tighten the receiver tank mounting hardware securely.
5. Pressurize the refrigeration system and check for leaks. If no leaks are found, evacuate the system.
6. Recharge the unit with refrigerant.

LIQUID LINE CHECK VALVE REPAIR

Removal

1. Remove the refrigerant charge.
2. Remove the cap nut from the check valve, and remove the spring and seat.



1.	Cap
2.	Gasket
3.	Spring
4.	Seat

Liquid Line Check Valve

Installation

1. Inspect the inside of the check valve body for damage or foreign particles that might adhere to the seat and damage the new seat. If the valve body is damaged, replace the check valve.
2. Install the new seat and spring. Place a new gasket on the cap and torque it to 45 ft-lb (61 N•m).
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, **evacuate the system**.
5. Recharge the unit with the proper refrigerant.

LIQUID LINE CHECK VALVE REPLACEMENT

Removal

1. Remove the refrigerant charge.
2. Unsolder the lines and remove the check valve.

   NOTE: Disassemble the valve before unsoldering.

Installation

1. Clean the tubes for soldering.
2. Place the disassembled check valve in position. The arrow on the valve body indicates the direction of refrigerant flow through the valve.
3. Solder the inlet and outlet connections. After the valve cools, reassemble the valve.
4. Pressurize the refrigeration system and test for leaks.
5. If no leaks are found, evacuate the system.
6. Recharge the unit with the proper refrigerant.

LIQUID LINE SOLENOID (LLS)

Removal

1. Remove refrigerant from the unit.
2. Remove the coil and disassemble the valve.
3. Unsolder the refrigeration lines and remove the valve from the unit.

CAUTION: Use a heat sink to prevent damage.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and disassemble the valve.
3. Place the valve in position and solder the refrigeration lines.

CAUTION: Use a heat sink to prevent damage.

4. After the valve cools, assemble the valve and install the coil.
5. Pressurize the system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Evacuate and recharge the unit.

HOT GAS SOLENOID (HGS)

Removal

1. Remove the refrigerant charge.
2. Remove the coil and disassemble the valve.
3. Unsolder the refrigeration lines and remove the valve from the unit.

CAUTION: Use a heat sink to prevent damage.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and disassemble the valve.
3. Place the valve in position and solder the refrigeration lines.

CAUTION: Use a heat sink to prevent damage.

4. After the valve cools, assemble the valve and install the coil.
5. Pressurize the system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Evacuate and recharge the unit.

COMPRESSORS SHIPPED WITH R-404A

The CD-II MAX compressors are ICE TK 208R compressors and are charged with Polyol Ester oil (POE) (TK No. 203-413). All gauge fittings are 1/4 inch fittings.

CAUTION: Polyol Ester (POE) is the only oil for use with Thermo King units using R-404A. It should not be added to standard Thermo King units, Nor should the standard or synthetic oil be added to systems containing R-404A. Combining the two oils could result in damage to the system.

Because Polyol Ester has an affinity for moisture, it must be kept in capped containers. In addition, it should be added as the last step in system repair. Rubber gloves are recommended when handling Polyol Ester because it may cause skin irritation.

EQUIPMENT RECOMMENDATIONS FOR USE WITH R-404A

Dedicated Equipment

CAUTION: Equipment that has been used with other refrigerants MUST NOT be used with R-404A refrigerants. Mixing R-404A with other refrigerants will cause contamination of the refrigerant. Using contaminated refrigerant will cause system failure.

Vacuum Pumps

When evacuating a two stage, three or five CFM pump is recommended. It is also recommended that dry nitrogen be used first. Ideally, a new vacuum pump should be used and dedicated for use with R-404A systems because residual refrigerants may remain in used vacuum pumps.

Pumps used with other Thermo King refrigerants may be used but extreme care should be taken to prevent contamination of R-404A systems with other refrigerants.

An oil filter, P/N 66-7462 is added.

The Thermo King Evacuation Station is recommended. This station is available from service parts under part number 204-725. See Truck and Trailer Service Bulletin T&T 061 for additional details.

Use only recommended vacuum pump oils and change oil after every major evacuation. Vacuum pump oils are highly refined and the use of contaminated oils will prevent the desired vacuum from being obtained. Failure to follow these recommendations may result in conditions that will destroy the vacuum pump.

Gauge Manifold Sets

Gauge manifold sets that show the correct pressure-temperature relationship should be used. Gauge manifolds and manifold hoses used with other Thermo King refrigerants may be used but extreme care should be taken to prevent contamination of the R-404A system with other refrigerants. Purge manifold and hoses with dry nitrogen before using. NEVER USE EQUIPMENT THAT MAY BE CONTAMINATED WITH AUTOMOTIVE TYPE POLYALKYLENE GLYCOL (PAG) OILS.

System Clean-up

Existing clean up devices such as suction line filters and compressor oil filters may be used if they are thoroughly cleaned and new filter elements are installed. All standard compressor oils must be removed from clean-up devices to prevent contamination of the R-404A system. Dangerous contamination will result if other refrigerants or standard oils are introduced to R-404A systems.

NOTE: For additional information on parts and supplies, consult your local Thermo King dealer and Thermo King Tool Catalog TK No. 5955.

Refrigerant Recovery

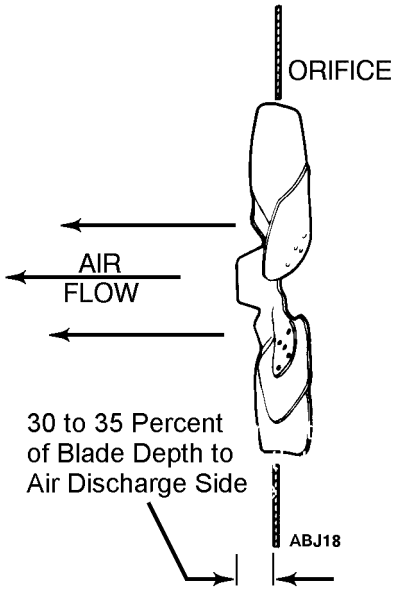
Present systems can be adapted to the recovery of R-404A but should be dedicated to the recovery of these refrigerants. Consult the manufacturer of your recovery equipment for details.

UNIT AND ENGINE MOUNTING BOLTS

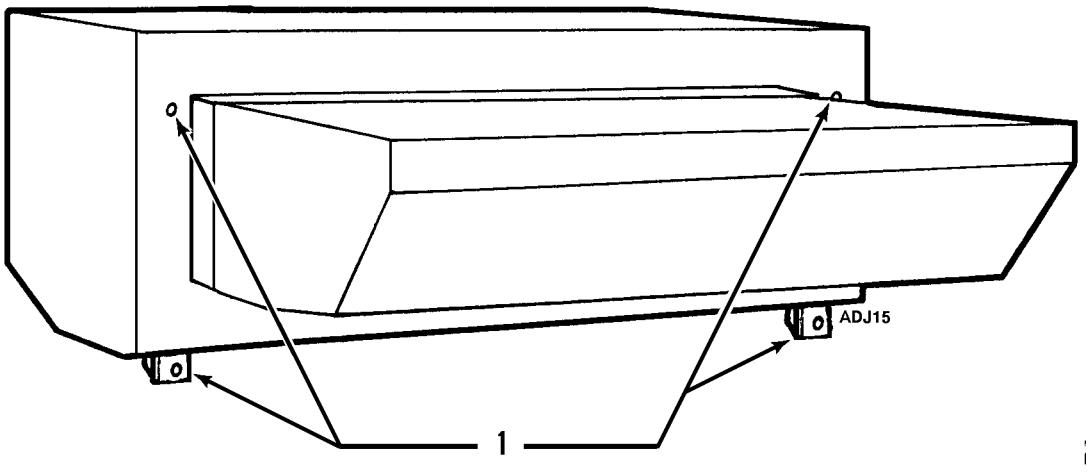
Periodically check and tighten all unit and engine mounting bolts. Torque the unit mounting bolts to 60 ft-lb (81 N•m). Torque the engine mounting bolts to 50 ft-lb (68 N•m).

FAN LOCATION

When mounting the fan and hub assembly on the motor or jackshaft, position the assembly in the orifice with 30 to 35 percent of the blade width to the air discharge side for proper fan performance.



Fan Blade Position in Orifice



1.	Check Mounting Bolts For Tightness

UNIT INSPECTION

Inspect the unit during pretrip inspections and scheduled maintenance inspections for loose or broken wires or hardware, compressor oil leaks, or other physical damage which might affect unit performance and require repair or replacement of parts.

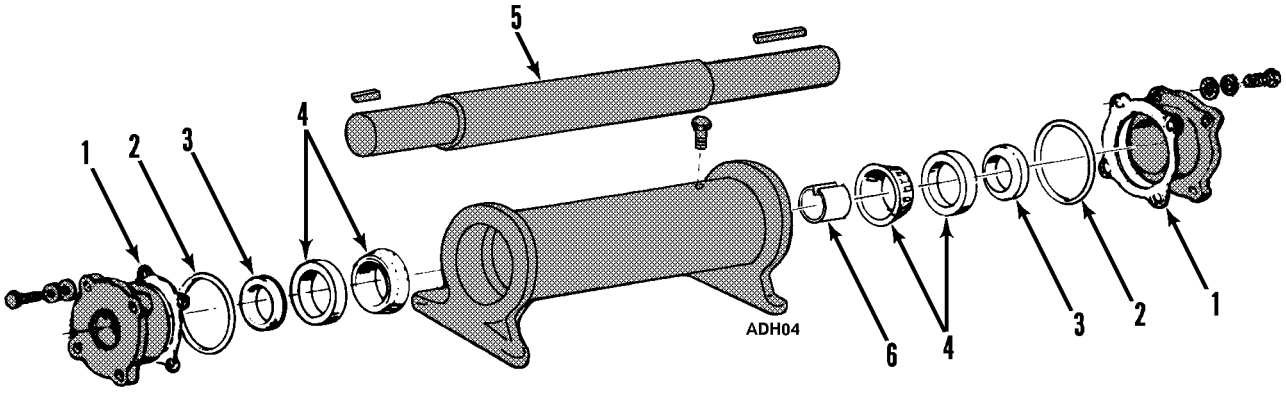
EVAPORATOR COIL

Clean the evaporator coil during scheduled maintenance inspections by blowing compressed air through the coil in the direction opposite the normal air flow. Inspect the coil and fins for damage and repair if necessary.

CAUTION: Air pressure should not be high enough to damage coil fins.

CONDENSER COIL

Clean the condenser coil during scheduled maintenance inspections by blowing compressed air from the back side of the coil out toward the front of the unit (direction opposite normal air flow). Inspect the coil and fins for damage and repair if necessary.



1.	Shim	4.	Bearing
2.	O-Ring	5.	Shaft
3.	Seal	6.	Oil Sling Retainer

Jackshaft Assembly

JACKSHAFT ASSEMBLY

The CD-II MAX 30 does not have electric standby capability, therefore, the electric motor is replaced by a jackshaft. The jackshaft assembly oil level plug should be removed, and the oil level checked every 1000 operating hours. Check the jackshaft during the pre-trip inspection for oil leakage. If there is any sign of leakage, remove the jackshaft assembly.

Model 30 truck units are equipped with jackshafts that have improved venting. This improvement was made by using a new air vent (P/N 55-6417), adding an oil sling retainer (P/N 77-2434), and using fanshaft oil (P/N 203-278). The new air vent, oil sling retainer, and fanshaft oil reduce the build-up of pressure inside the jackshaft.

Disassembly

1. Remove jackshaft assembly from the unit and remove the pulleys.
2. Remove the level and fill plugs and drain oil reservoir.
3. Remove bearing retainer cap from fill plug end of the jackshaft assembly.

   NOTE: There are shims between the bearing retainer cap and the housing. These should be saved for possible reuse during reassembly.

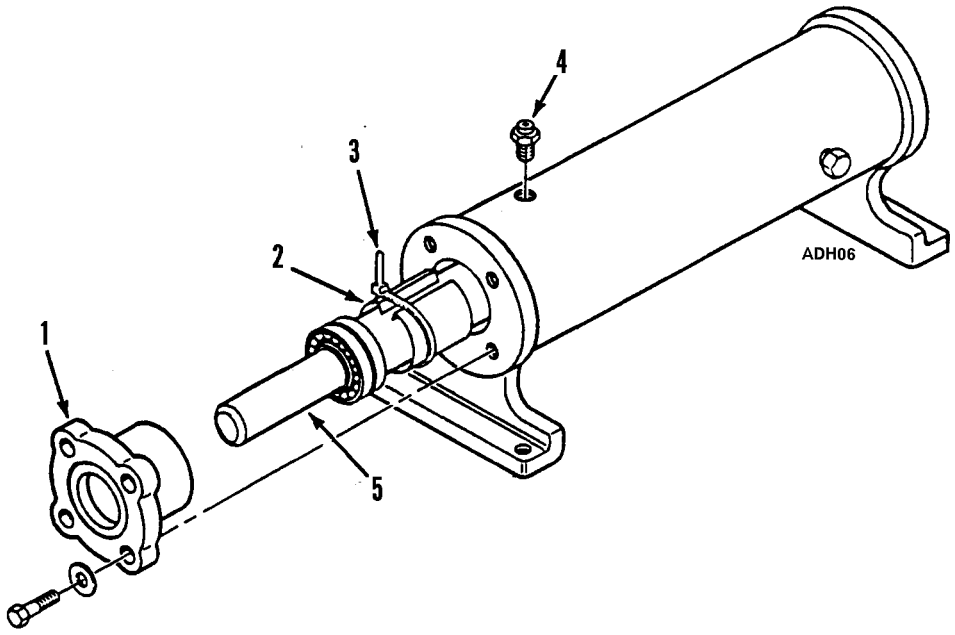
4. Remove the shaft and bearings.

   NOTE: The oil sling retainer is pulled out by the bearing assembly on shaft.

5. Remove the retainer cap from level plug end of assembly.
6. Use a punch and hammer to remove the seals and bearing cups from bearing retainer caps.
7. Use a bearing splitter or similar tool to remove the bearing cones from the shaft.
8. Clean all parts in clean solvent and then examine the bearing cups and cones for damage.

Reassembly

1. Coat the edges of the oil seals with a gasket sealant.
2. Using a suitable tool, install the seals in the end caps. Fill the space between the seal lips with grease. Install the assembled end cap (seal and bearing race installed) on the oil level plug end of jackshaft housing.
3. Place the oil sling retainer on the shaft. If the bearings were removed from the shaft, place the oil sling retainer on the shaft while installing the bearings. If the bearings were not removed from the shaft, press the oil sling retainer onto the shaft through the opening in the top of the oil sling retainer.
4. Use a tie band or a hose clamp as tool to compress the oil sling retainer enough to fit inside the jackshaft housing.
5. Install the shaft into the jackshaft housing with oil sling retainer on the shaft with bearing. Align the opening in the oil sling retainer with the air vent opening in the top of the jackshaft housing.
6. Use a punch and hammer to tap the oil sling retainer into the jackshaft housing until it is centered beneath the air vent opening and past the housing lip that holds the outer race.
7. Remove the tie band or hose clamp.

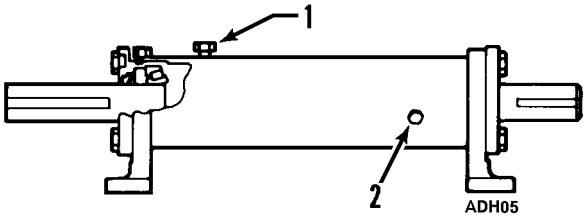


1.	End Cap	4.	Air Vent (P/N 55-6417)
2.	Oil Sling Retainer	5.	Shaft
3.	Tie Band		

Installing Oil Sling Retainer

8. Install the remaining end cap.
9. Torque the bolts to 10 ft-lb (13.6 N•m).
10. Check end play of the shaft with a dial indicator. End play should be between 0.001 to 0.005 in. (0.025 to 0.127 mm). Change shims if necessary.

Pour 3.5 ozs (104 ml) of fanshaft oil P/N 203-278 into the jackshaft housing.



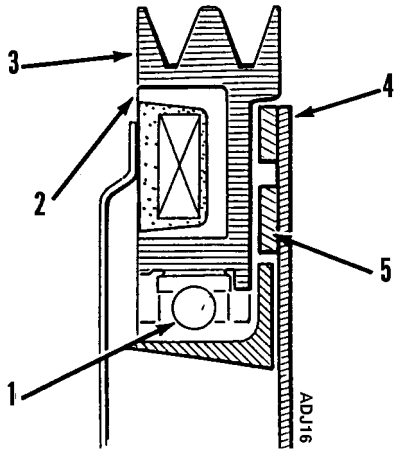
1.	Fill Plug And Vent
2.	Oil Level Plug

Jackshaft Assembly

COMPRESSOR CLUTCH

Operation

A stationary field coil is mounted on the compressor body concentric with the shaft. A pulley assembly, consisting of a pulley, a disc and a hub, is mounted on the shaft of the compressor. The hub and disc are flexibly connected by flat springs that, in the disengaged position, hold the disc slightly away from the pulley web (friction surface).



1.	Hub
2.	Stationary Field Coil
3.	Pulley
4.	Disk
5.	Flat Springs

Compressor Clutch Assembly

Clutch Test

1. If the field coil lead wire is broken, replace the field coil.
2. Check the amperage and voltage. The amperage range should be 3.6 to 4.2 at 12 volts or 1.8 to 2.1 at 24 volts. Note the following symptoms and conditions:
   a. A very high amperage reading—a short within the field coil.
   b. No amperage reading—an open circuit in the winding.
   c. An intermittent or poor system ground results in lower voltage at the clutch. Check for tight fit on the coil retaining snap ring or for good ground at the coil retaining screws.
   d. Replace field coil if it has an open or short circuit.

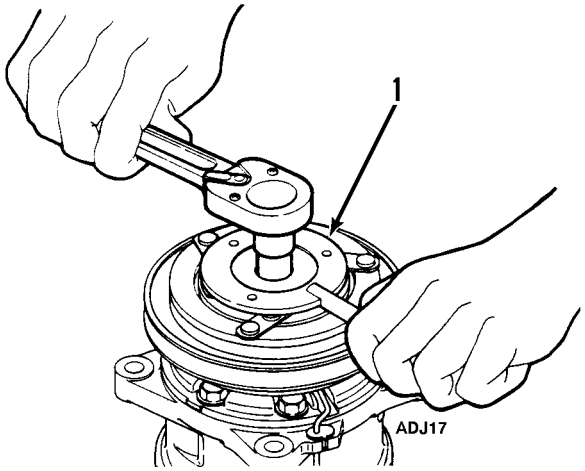
3. Air Gap—An incorrect air gap could cause erratic engagement or disengagement and/or clutch rattle. Check the air gap with a feeler gauge (0.016 to 0.031 in. [0.4 to 0.8 mm]). Adjust based on Clutch Installation chapter.

Clutch Removal

NOTE: Make sure the proper tools are available before performing maintenance procedures. Refer to the tool listing at the end of this chapter for tools required. Contact your local Thermo King dealer for further information.

Removal

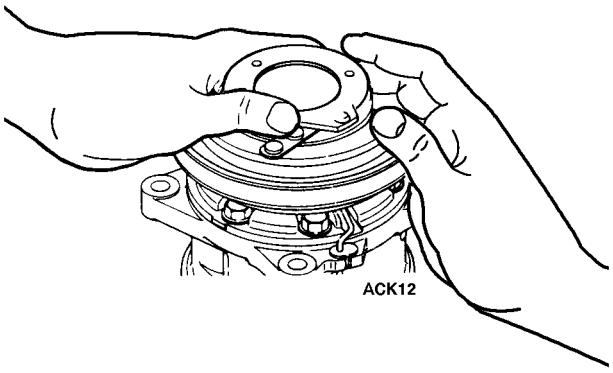
1. Remove the center bolt using the puller arbor (TK 204-804) to prevent drive plate rotation.



1.	Holder

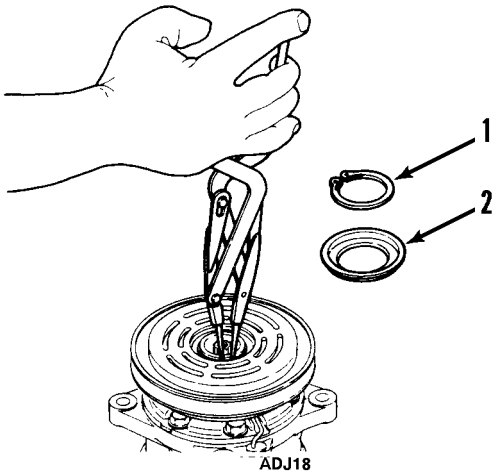
Remove Center Bolt

2. Remove the drive plate using the shaft seal kit (TK 204-805). Then remove the shims from either the drive shaft or the drive plate.



Remove Drive Plate

3. Remove the snap ring using external snap ring pliers (TK 204-808).
4. Remove the cover.

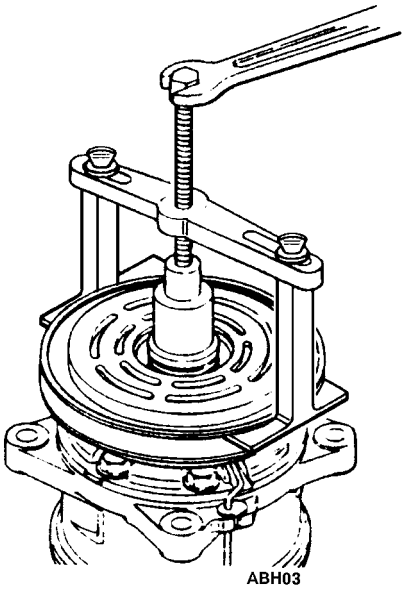


1.	Snap Ring
2.	Cover

Remove Snap Ring and Cover

5. Remove the pulley assembly using the clutch remover (TK No. 204-806) and the spacer positioned on the cylinder head hub.

   NOTE: To avoid damaging the pulley groove, the pulley claws should be hooked into (NOT UNDER) the pulley groove.

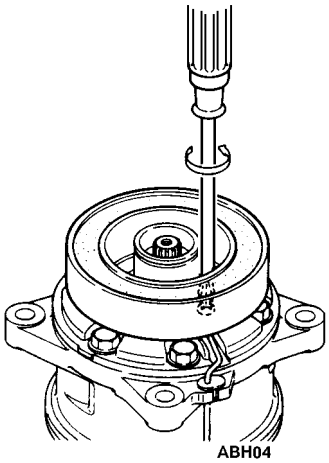


Remove Pulley

6. Remove the coil's lead wire from the holder on the top of the compressor.

7. Remove the three screws that attach the coil to the compressor and remove the coil.

NOTE: DO NOT hold the coil by the lead wire.



Remove Coil

Inspection

1. **Drive Plate**

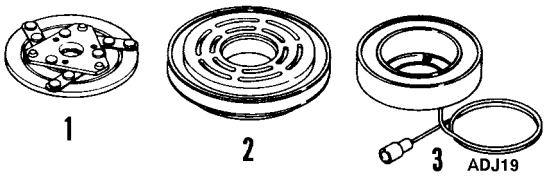
   If the contact surface is scorched, the drive plate and pulley should be replaced.

2. **Pulley Assembly**

   Inspect the appearance of the pulley assembly. If the pulley's contact surface is excessively grooved due to slippage, both the pulley and drive plate must be replaced. There should also be no foreign matter, such as oil or grit, lodged between the clutch plate and pulley. Thoroughly clean these contact surfaces and the drive plate.

3. **Coil**

   Inspect the coil for a loose connector or cracked insulation. If the insulation is cracked, replace the coil. Repair or replace the wire or the connector if either is loose or damaged.



1.	Drive Plate
2.	Pulley Assembly
3.	Coil

Inspect Components

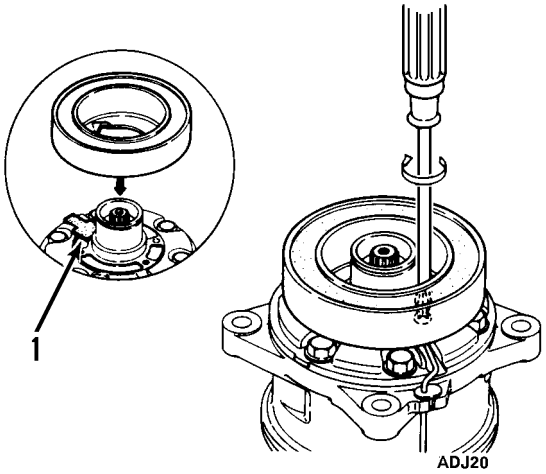
Clutch Installation

NOTE: Before installation refer to the "Inspection" procedures previously described.

1. Confirm that the felt is installed on the front of the cylinder head.
2. Install the coil on the compressor (with the lead wire on top). At this time, confirm that the coil's concave portion is aligned with the felt and then tighten the mounting screws to the specified torque.

   NOTE: Specified torque: 2.9 to 4.3 ft-lbs (0.4 to 0.6 kgm).

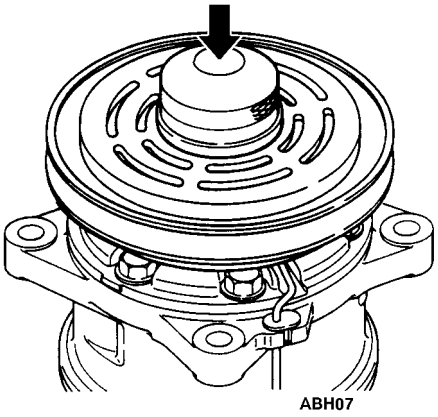
3. Install the lead wire in the wire holder on the compressor.



Install Coil

1.	Felt

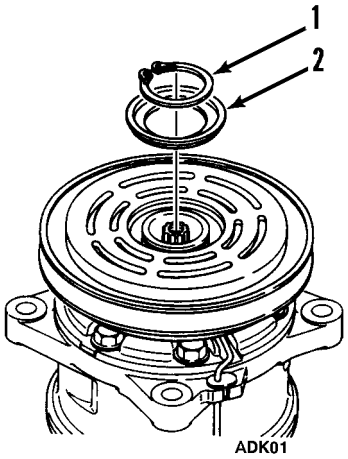
4. Install the pulley assembly using the compressor holder (TK No. 204-807) and a hand press.



Install Pulley

5. Install the cover and the snap ring using external ring pliers.

   NOTE: When installing the snap ring, the chamfered inner edge of the snap ring should face upward.



1.	Snap Ring
2.	Cover

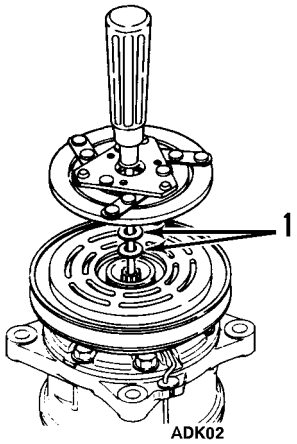
Install Cover and Snap Ring

6. Install the driver plate on the drive shaft, together with the original shim(s). Press the drive plate down by hand.

7. Tighten the bolt to the specified torque using the puller arbor (TK No. 204-804) to prevent drive-plate rotation.

   NOTE: Specified torque: 8.7 to 10.1 ft-lbs (1.2 to 1.4 kgm).

   After tightening the bolt, ensure that the pulley rotates smoothly.



1.	Shims

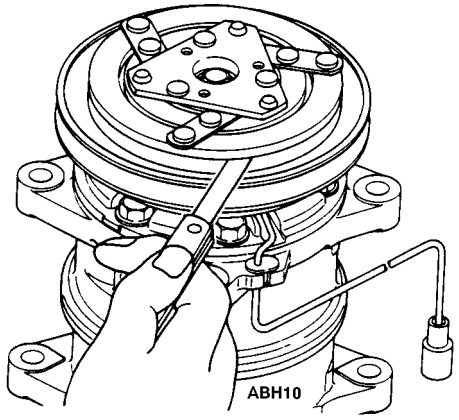
Install Shims and Drive Plate

8. Ensure that the clutch clearance is as specified. If necessary, adjust the clearance using shims.

   Adjusting shims are available in the following thicknesses:

Shim TK P/N	Thickness in. (mm)
TK 11-8031	0.0039 in. (0.1 mm)
TK 11-8032	0.0118 in. (0.3 mm)
TK 11-8033	0.0197 in. (0.5 mm)

NOTE: Specified clearance: 0.01 to 0.02 in. (0.3 to 0.6 mm).



Check Clearance

Electrical Connection

1. Connect the lead wire to the electrical circuit.

   NOTE: The stationary field is grounded at the factory; therefore, it is necessary only to connect the hot (lead) wire.

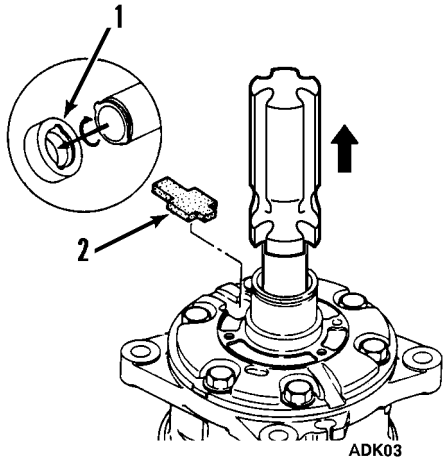
2. Engage and disengage the clutch several times to check the clutch engagement. The disc should snap firmly against the pulley.

SHAFT SEAL COVER AND SHAFT SEAL

Removal

1. Remove the magnetic clutch assembly, as outlined in "Magnetic Clutch Removal" section of this manual.
2. Remove the felt pad.
3. Use the seal remover (from the shaft seal kit P/N 204-805) to remove the shaft seal cover. Turn the seal remover to engage the hook on the seal remover with the hook on the shaft seal cover, then slowly pull the shaft seal cover out of the cylinder head.

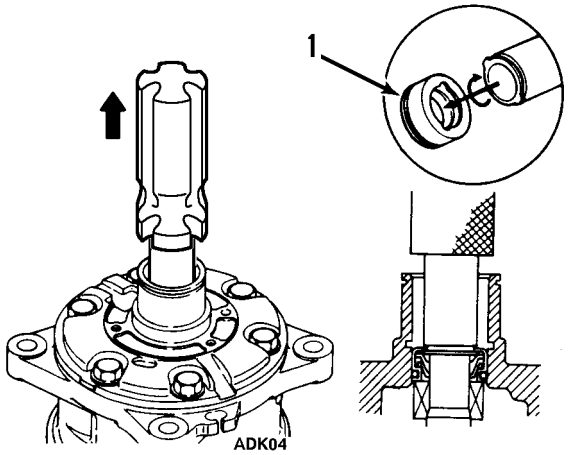
   NOTE: The shaft seal cover SHOULD NOT be reused. Always use a new shaft seal cover when reassembling a compressor.



1.	Shaft Seal Cover
2.	Felt Pad

Remove Shaft Seal Cover

4. Use the seal remover (from the shaft seal kit P/N 204-805) to remove the shaft seal. Turn the seal remover to engage the hook on the seal remover with the hook on the shaft seal, then slowly pull the shaft seal out of the cylinder head.

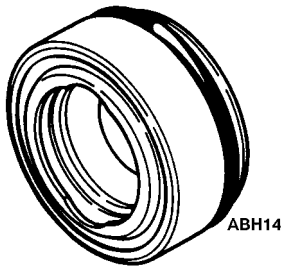


1.	Shaft Seal

Remove Shaft Seal

Inspection

The shaft seal should not be reused. Always use a new shaft seal when reassembling a compressor. Be extremely careful to make sure the lip of the shaft seal that is being installed is not scratched or damaged in any way. Make sure the shaft seal is free from lint and dirt that could damage the shaft seal surface.

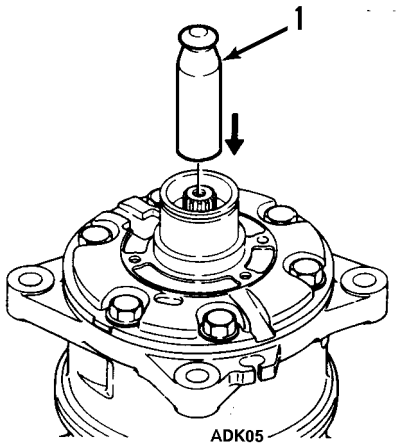


Inspect Shaft Seal

Installation

Before installing a shaft seal inspect it carefully (see Inspection).

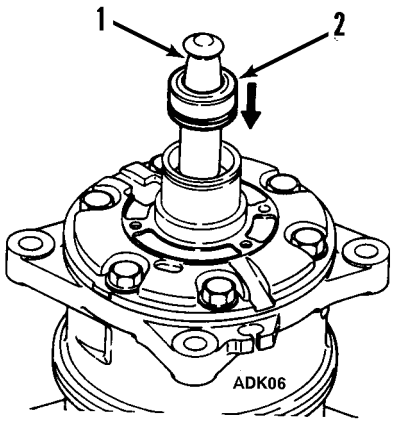
1. Clean the section of the front cylinder head that holds shaft seal.
2. Apply clean compressor oil to the new shaft seal and to the front cylinder head. If the slip surfaces are dirty, clean them with thinners, dry the clean surfaces and apply clean compressor oil.
3. Place the seal guide (from the shaft seal kit P/N 204-805) on the end of the shaft.



1.	Seal Guide

Place Guide on Shaft

4. Place the shaft seal on the seal guide and slide the seal into the cylinder head.

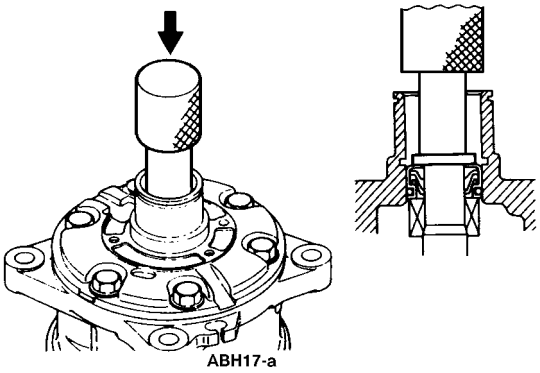


1.	Seal Guide
2.	Shaft Seal

Place Shaft Seal on Guide

5. Use the seal installer (from the shaft seal kit P/N 204-805) to press the shaft seal into the cylinder head as far as possible.

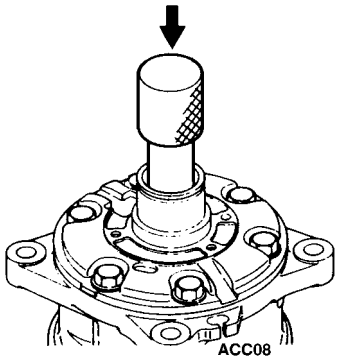
6. Remove the seal guide from the shaft.



Press Seal Into Cylinder Head

7. Place the seal guide (from the shaft seal kit P/N 204-805) on the end of the shaft.

8. Place the shaft seal cover on the seal guide and slide the shaft seal cover into the cylinder head.

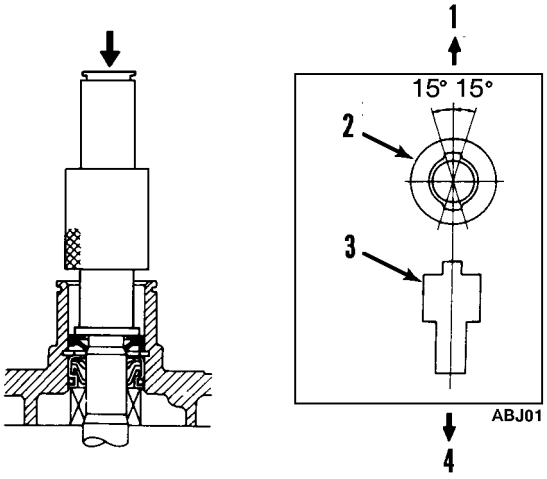


Install Shaft Seal Cover

9. Use the seal installer (from the shaft seal kit P/N 204-805) to press the shaft seal cover into the cylinder.

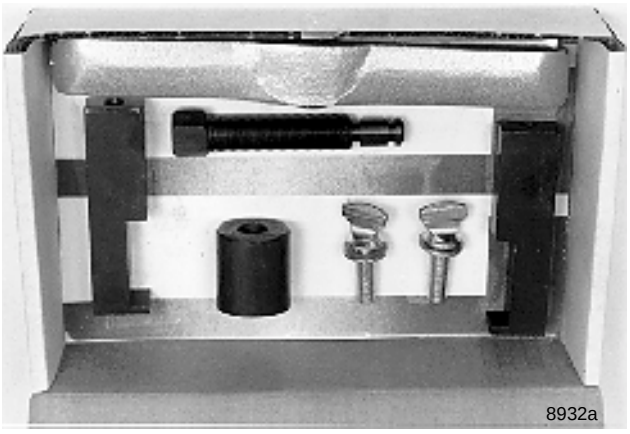
10. Remove the seal guide from the shaft.

NOTE: Position the shaft seal cover as shown in the illustration. The felt pad should also be replaced with a new one when the shaft seal is replaced.

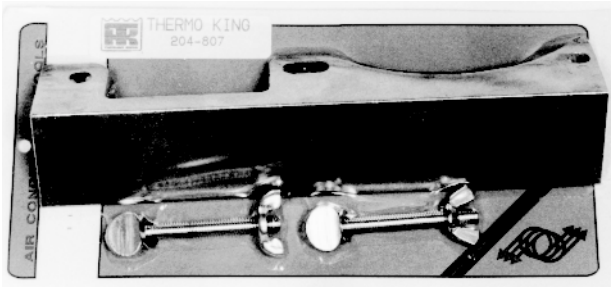


Proper Shaft Seal Cover Position

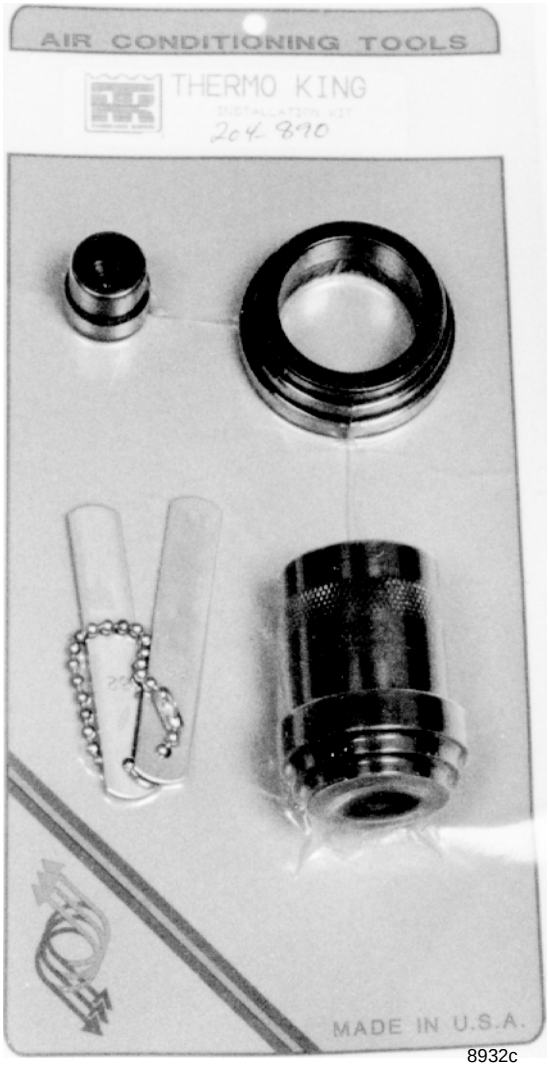
SPECIAL TOOLS



Clutch Remover P/N 204-806



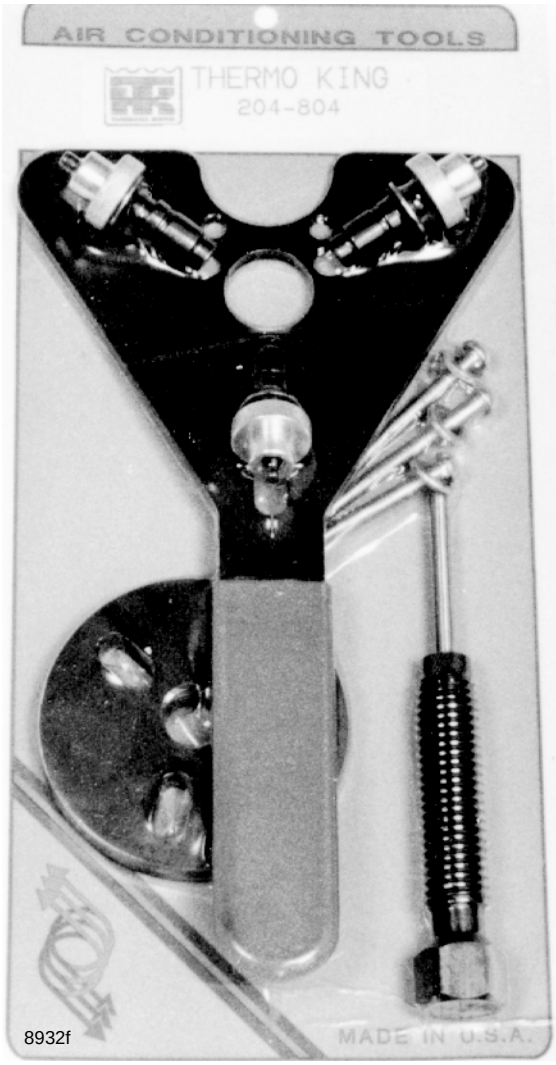
Compressor Holder P/N 204-807



Clutch Installation Kit P/N 204-890

Snap Ring Pliers P/N 204-808

Shaft Seal Kit P/N 204-805



Pulley Arbor P/N 204-804

SYSTEM COMPRESSOR AND OIL

Installation of the Compressor

The compressor is mounted in the condenser section. The side to side mounting angle of the compressor must remain ± 45° from the horizontal. The forward to backward angle must be within ± 10° of horizontal. Access to the air conditioning system service ports is from the top of the unit.

Each compressor comes with a standard charge of Polyol Ester (POE) oil inside. This quantity of oil is enough to supply the compressor lubrication when it is installed into an already “oil wet” system. New systems require an extra quantity of oil be added to “wet” all the interior surfaces of the system.

During normal operation there is always a quantity of oil that travels around inside the system. This oil lubricates all the components, returns to the compressor for a while, and again travels around the system.

Adding Extra Oil to the System

The initial oil charge into a new system is based on the size of the system and the amount of oil, which remains in the compressor during operation.

The correct oil to use in the CD-II MAX using R-404A is Polyol Ester (POE) oil (P/N 203-413). Any extra or replacement oil should be placed into the system at the receiver tank port.

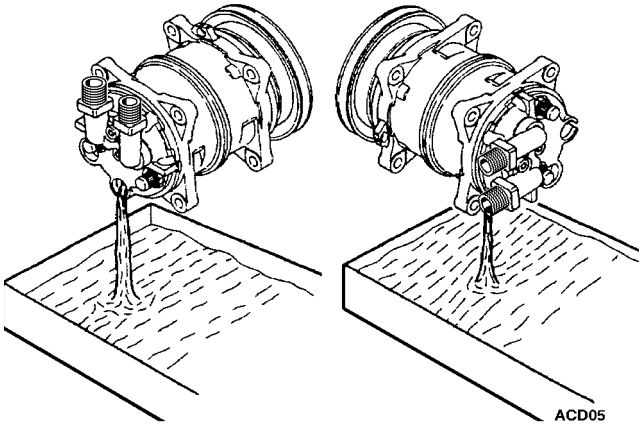
CAUTION: Keep all oil containers tightly sealed from the air. Oil tends to absorbed moisture from the air and can become contaminated if left open. If contaminated oil is put into a system, it may damage the components of the system.

Major Loss of Refrigerant

In case of a major loss of refrigerant, it must be assumed that some system oil is lost also. The oil level should be verified by the “Checking the Oil Level” method in this manual.

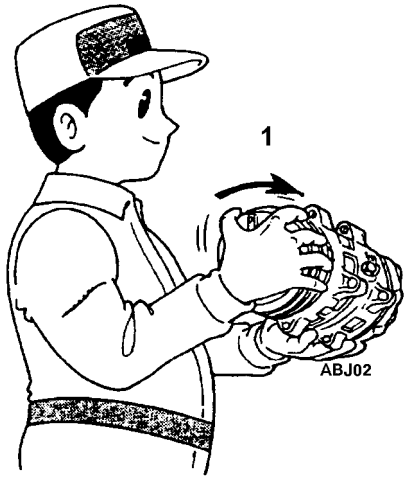
Checking the Oil Level

Drain the Oil



Draining the Oil

Remove the compressor from the unit and drain the oil from the compressor drain plug and all other ports. Turn the clutch (rotating the internal compressor parts) by hand and drain oil again. Repeat until all oil is removed from the compressor. Measure the oil in liquid ounces. Also, inspect the oil for signs of contamination.



Oil contamination:

1. Dirt in the oil.
2. Color changed to a varnish color.
3. Presence of foreign substances, metal shavings, etc. in the oil.

NOTE: Always replace oil with new fresh oil taken from a sealed container only.

NOTE: Always replace the system filter-drier anytime the system has been opened for service.

When a System Becomes Contaminated

A severely contaminated system may be indicated by black oil in the compressor. If severe contamination occurs, it will be necessary to flush the complete system. If flushing is required, use industry approved materials.

In all cases when this occurs you must determine the extent of contamination. Do this by removing the filter-drier and determine if the darker colored oil is present at that point of the system too. If it is, flushing the system is recommended.

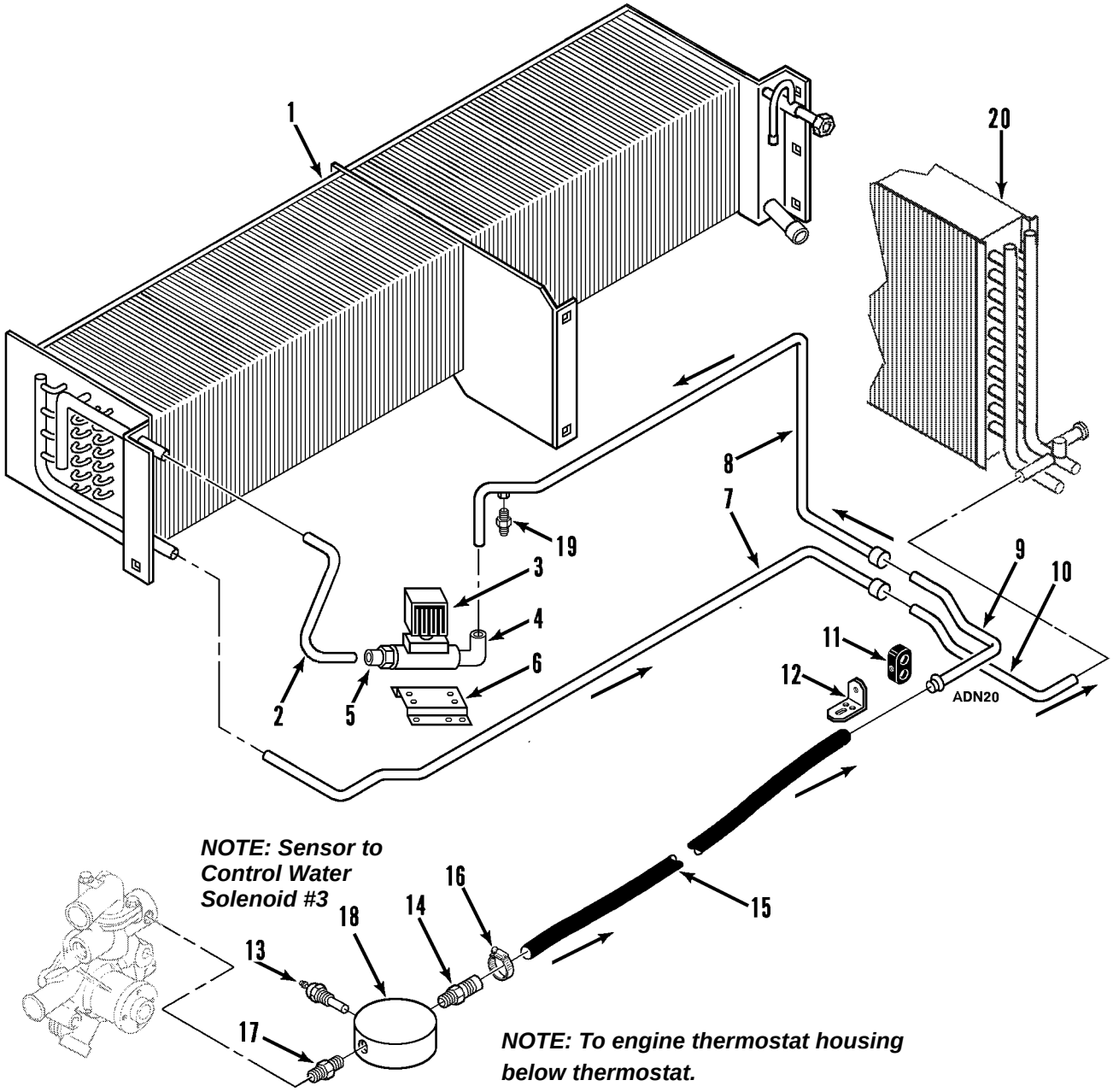
If the oil appears clean at the filter-drier, install a new filter-drier and replace the compressor with clean new oil. Refer to checking and draining the compressor oil section for details.

CAUTION: Any extra or replacement oil should be placed into the system at the receiver tank port.

Hot Water Heat Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit not cooling	Stuck coolant valve; solenoid bad	Repair or replace
Unit not heating	Coolant valve stuck open	Replace thermostat
	No electrical signal	Check for power on 26 wire
	Heater coil heavily scaled	Replace heater coil
	Evaporator water temperature thermostat inoperative	Replace thermostat
Loss of coolant	Leaking hoses, tubing or connections	Repair or replace as required

Hot Water Heat Option



1.	Special Evaporator Coil with Water Tubes	11.	Clamp - Tubes
2.	Tube - Valve to Coil	12.	Bracket - Guard (Belt/Tube)
3.	Water Valve - (Evaporator)	13.	Switch - Water Temperature
4.	Elbow - 90°	14.	Adapter
5.	Adapter	15.	Hose - Water
6.	Water Bracket - Valve	16.	Clamp - Hose (EPDM)
7.	Tube - Water (Evaporator to Radiator)	17.	Water Nipple
8.	Tube - Water (Inlet, Engine to Valve)	18.	Water Adapter
9.	Tube - Water (Engine to Evaporator)	19.	Air Bleed Screw
10.	Tube - Water (Return to Radiator)	20.	Radiator

CONDITION	POSSIBLE CAUSE	REMEDY
UNIT switch ON—nothing happens	Dead battery	Recharge or replace battery
	REMOTE switch OFF (optional)	Turn ON
	Circuit breaker open	Replace or reset
	Corroded battery connections	Clean and tighten
	RESET switch open	Correct cause—push in button
	Control circuit fuse blown	Check for shorted main harness and replace 60 amp control circuit fuse
UNIT switch ON—indicator lights come on but engine does not crank	Battery low	Replace or recharge battery
	DIESEL/ELECTRIC switch in ELECTRIC position	Flip switch to DIESEL
	Circuit breaker open	Push in RESET button
	Starter solenoid defective	Repair or replace
	Starter relay defective	Replace relay
	Corroded battery connections	Clean and tighten
	Starter clutch defective	Replace
	Starter defective	Repair or replace
	STARTER switch defective	Replace
Engine cranks but FAILS to start	Misadjusted fuel solenoid linkage	Adjust
	Fuel solenoid not energized	Check 8D circuit, fuel solenoid timer and relay
	Fuel solenoid defective	Replace solenoid
	No fuel or wrong fuel in tank	Fill fuel tank. After filling a completely empty tank, first bleed fuel system.
	Engine too cold	Use winter preheat procedure
	Glow plugs defective	Replace glow plugs

CONDITION	POSSIBLE CAUSE	REMEDY
Engine cranks but FAILS to start (continued)	Air in fuel system	Bleed fuel system. During this operation, it can also be determined if the fuel lines are tight and filters clean.
	Speed/run relay malfunction	Check relay or unit thermostat
	Insufficient compression	Measure compression pressure. If necessary, grind valves or replace piston
	Electric fuel pump not operating	Check pump for running and 8 to 10 psig (55 to 69 kPa). Repair or replace fuel pump
	Injection pump incorrectly timed	Adjust timing
	Faulty injection nozzle(s)	Repair injection nozzle or replace it
	Faulty injection pump	Have pump repaired
Engine stops after starting	Air in injection pump	Bleed fuel system
	Fuel filter obstructed	Replace filter element
	High water temperature coolant	Add coolant. Check for leaks
	Low oil pressure	Add oil. Check for leaks
	Vent of fuel tank obstructed	Remove obstruction
	Electric fuel pump not operating	Check pump for running and 8 to 10 psig (55 to 69 kPa). Repair or replace fuel pump
	Dry air cleaner (optional) plugged	Change filter element
	Fuel solenoid not energized	Change filter element
	Button pops out on reset switch	Check 8D circuit
	High refrigerant pressure	Locate and correct cause
Engine does not reach full power	Air or dirt in fuel system	Adjust
	Fuel line leaks	Tighten connections of fuel lines. if necessary, replace damaged lines
	Speed adjustment wrong	Adjust speed
	Electric fuel pump does not run	Check voltage. Repair or replace pump

CONDITION	POSSIBLE CAUSE	REMEDY
Engine does not reach full power (continued)	Fuel filter blocked	Install new filter
	Electric fuel pump filter dirty	Clean and replace diesel filter
	Delivery of fuel pump insufficient	Repair or replace pump
	Cylinder head gasket leaking	Replace gasket
	Piston rings worn, stuck or broken	Replace rings
	Cylinder worn	Replace or bore
	Leaking injection nozzle or irregular injection caused by fouling	Clean and repair nozzle
	Insufficient compression pressure due to faulty piston or valves	Check cylinder with compression tester. if necessary, grind valves or replace piston
	Air filter clogged	Clean air filter
	Fuel tank vent clogged	Unclog vent
	Injection rate too low	Adjust pump discharge rate
	Insufficient injection pressure	Readjust or replace nozzle
	Pump injects too early or too late	Adjust injection pump timing
	Air in fuel system	Bleed fuel system
	Air is drawn into fuel pump	Check all fuel lines and fittings
	Loose governor assembly	Check and repair governor assembly
	Restricted exhaust system	Clean or replace restricted parts
Engine is sooting heavily, emits thick black clouds of smoke (excessive fuel to air ratio)	Wrong fuel	Drain and refill with correct fuel
	Clogged air intake system	Clean air cleaner
	Restricted exhaust system	Clean or replace
	Opening pressure of nozzle is too low or needle sticks	Repair nozzle. Replace if necessary
	Injection amount too great	Have pump repaired
	Oil being drawn in	Check oil level in oil bath air filter
	Injection pump too timed	Check timing of injection pump
	Excessive load	Check drive system and engine oil pressure

CONDITION	POSSIBLE CAUSE	REMEDY
Engine knocks	Insufficient air	Clean air filter
	Air in fuel system	Bleed fuel system
	Engine is cold	Warm up
	Fuel return line plugged	Remove restriction
	Injection pump not timed	Retime injection pump
	Injection nozzle fouled or opening pressure too low	Clean, repair or replace injection nozzle
	Dirty radiator	Clean radiator
	Worn engine parts	Overhaul engine
Engine runs hot	Engine coolant is low	Add coolant slowly while engine is in operation
	Dirty or plugged radiator	Clean radiator
	Cooling system heavily scaled	Clean cooling system
	Water pump leaks	Repair or replace water pump
	Worn or loose belt	Replace belt or adjust
	Cylinder head gasket leaks (bubbles appear in radiator if cylinder gasket is leaking)	Replace cylinder head gasket. Correct gasket
	Faulty thermostat	Check or replace the thermostat
	Faulty temperature gauge	Replace gauge
Oil pressure too low or drops suddenly. Minimum oil pressure for a hot engine is 10 psig (69 kPa), setting on the LOW OIL PRESSURE switch.	Insufficient oil in pan	Refill oil base after correcting cause of loss
	Leak in oil line	Tighten oil line fittings
	Oil relief valve sticking	Disassemble and clean oil pressure regulator valve
	Faulty oil pressure gauge	Check oil line to oil pressure gauge to see if it is blocked. Check oil pressure gauge. Replace if necessary

CONDITION	POSSIBLE CAUSE	REMEDY
Oil pressure too low or drops suddenly (continued)	Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug, oil in water through crack	Repair engine
High oil consumption	Oil leakage	Check and eliminate possible causes
	Clogged air cleaner	Clean air cleaner
	Damaged valve seals	Replace seals on valve stem
	Worn valve stem or valve guides	Replace valves and valve guides
	Broken piston rings or cylinder bore worn or scored	Have engine repaired. Replace broken piston rings
	Crankcase breather clogged	Clean crankcase breather
Blue Smoke (oil consumption)	Excessive oil consumption	Refer to High Oil Consumption. Repair as necessary
White Smoke (fuel is not burning)	Cold engine	Allow engine to warm up
	Low compression	Check and eliminate possible causes. Repair as necessary
	Timing	Readjust timing
	Air or water in fuel	Bleed system. Replace filters, clean fuel system, drain and clean tank and check supply tank for water. Use known good fuel
	Insufficient preheat	Check glow plugs
Battery is not recharging	Loose alternator belt	Tighten belt
	Loose connections in electrical system	Check all electrical connections and charging system
	Worn brushes in alternator	Repair
	Voltage regulator faulty	Replace
	Battery defective	Replace
	Alternator defective	Repair or replace

CYCLE-SENTRY Diagnosis

CONDITION	POSSIBLE CAUSE	TEST PROCEDURE
Unit will not energize the run relay when required	Defective run relay	Test run relay
	Open 7A circuit from selector switch to run relay	Test 7A circuit
	Defective selector switch	Test circuit from 7M to 7A on switch in the start-stop function
	Defective load temperature thermostat	Check load temperature thermostat in Continuous Run mode
	Open D7 or D8 diodes	Test D7 and D8 diodes
	Defective CYCLE-SENTRY module	Test CYCLE-SENTRY module
	Open 53 circuit from run relay to CYCLE-SENTRY module	Test 53 circuit
Preheat relay will not energize when required	Defective preheat relay	Test preheat relay
	Open 52A circuit from preheat relay to CYCLE-SENTRY module	Test 52A circuit
	Open D7 or D8 diodes	Test D7 or D8 diodes
	Defective CYCLE-SENTRY module	Test CYCLE-SENTRY module
	Open CH circuit to CYCLE-SENTRY module	Test CH circuit
	Open 7A circuit from selector switch to the preheat relay	Test 7A circuit
	Open 2A circuit to preheat relay (after 9-89)	Test 2A circuit
Unit will not automatically crank, but will preheat automatically	Defective CYCLE-SENTRY module	Test CYCLE-SENTRY module
	Open 52 circuit from start relay to starter	Test 52 circuit
	Open 8S circuit from start relay to starter	Test 8S circuit
	Defective start relay	Test start relay
	Defective starter	Test starter

CONDITION	POSSIBLE CAUSE	TEST PROCEDURE
Unit will not automatically crank, but will preheat automatically (continued)	Open 8 circuit to starter relay (after 9-89)	Test 8 circuit
	Open 7A circuit to starter relay	Test 7A circuit
Unit disengaged starter before engine is running	Defective CYCLE-SENTRY module	Test CYCLE-SENTRY module
	Low battery condition	Test battery under load
	Defective starter	Test starter in Continuous Run mode
Unit does not disengage starter when engine is started	Defective starter	Test starter in Continuous Run mode
	Defective RPM sensor	Test 52A circuit
	Open or grounded FS-1 or FS-2 circuit from RPM sensor to CYCLE-SENTRY module	Test FS-1 or FS-2 circuit
	Defective CYCLE-SENTRY module	Test CYCLE-SENTRY module
Unit turns ON and RESET switch trips	Unit fails to start (normal indication)	Test for normal starting in Continuous mode
	Open 52 circuit from start relay to CYCLE-SENTRY module	Test 52 circuit
	Open 8S circuit from start relay to starter	Test 8S circuit
	Defective CYCLE-SENTRY module	Test CYCLE-SENTRY module
Standard 4-mode unit has no low speed cool in automatic start-stop mode (unit shuts off after high speed cool	Defective thermostat	Test thermostat
	Open diode D6	Test D6 diode
Standard 4-mode unit will not initiate start from defrost	Open 29 circuit	Test 29 circuit to PC board
	Open D11 diode or R9 resistor, or 29T circuit on PC board	Test D11 diode or R9 resistor and 29T circuit on PC board to thermostat
	Defective thermostat	Test unit thermostat

CONDITION	POSSIBLE CAUSE	TEST PROCEDURE
Unit will not initiate start if engine temperatures drop below 60 F (15.5 C)	Defective block temperature thermostat	Test block temperature thermostat
	Open 8B circuit to block temperature thermostat	Test 8B circuit
	Open 7A circuit from block temperature thermostat to run relay	Test 7A circuit
Unit will not stop when load temperature thermostat is satisfied	Defective block temperature thermostat switch	Test block temperature thermostat switch
	Defective load temperature thermostat	Test load temperature thermostat in Continuous Run mode
	Engine temperature below 120 F (49.0 C)	Check engine temperature after warm up
	Battery not charged	Charge battery
	Defective battery sentry	Replace battery sentry
	Charging system faulty	Correct charging system

Electric Standby (Optional) Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
UNIT switch ON—indicator lights do not come on	Battery discharged	Charge or replace battery
	Remote switch off	Turn ON switch (optional)
	Circuit breaker or SAFETY switch open	Push in button. Replace switch if defective
	Electric MOTOR RESET switch tripping	Check for short circuit in unit wiring (high voltage)
	Control circuit fuse blown	Replace 60 amp control circuit fuse
	Dirty battery terminals	Clean and retighten terminals
UNIT switch ON—indicator lights come on but electric motor does not run	DIESEL/ELECTRIC switch on DIESEL	Move switch to ELECTRIC position
	No standby power	Provide power to unit; check power at: 1. Power source 2. Power plug 3. Motor contactor hot side 4. Motor contactor load side (contactor closed) 5. Overload relay 6. Motor terminals
	Defective motor contactor	Repair or replace motor contactor
	Defective LOW OIL PRESSURE switch	Replace LOW OIL PRESSURE switch
	Overload relay tripping	Check for shorted motor windings or wires
	Defective motor	Replace motor
	Batteries discharged	Charge ore replace batteries
Electric motor hums but does not run	Locked rotor (overload relay will open after a period of time)	Remove interference
	Locked compressor	Repair compressor
	Defective clutch on engine (locked up)	Repair or replace clutch
	Low line voltage or no voltage on one leg	Bring voltage up to within 10% of motor rating

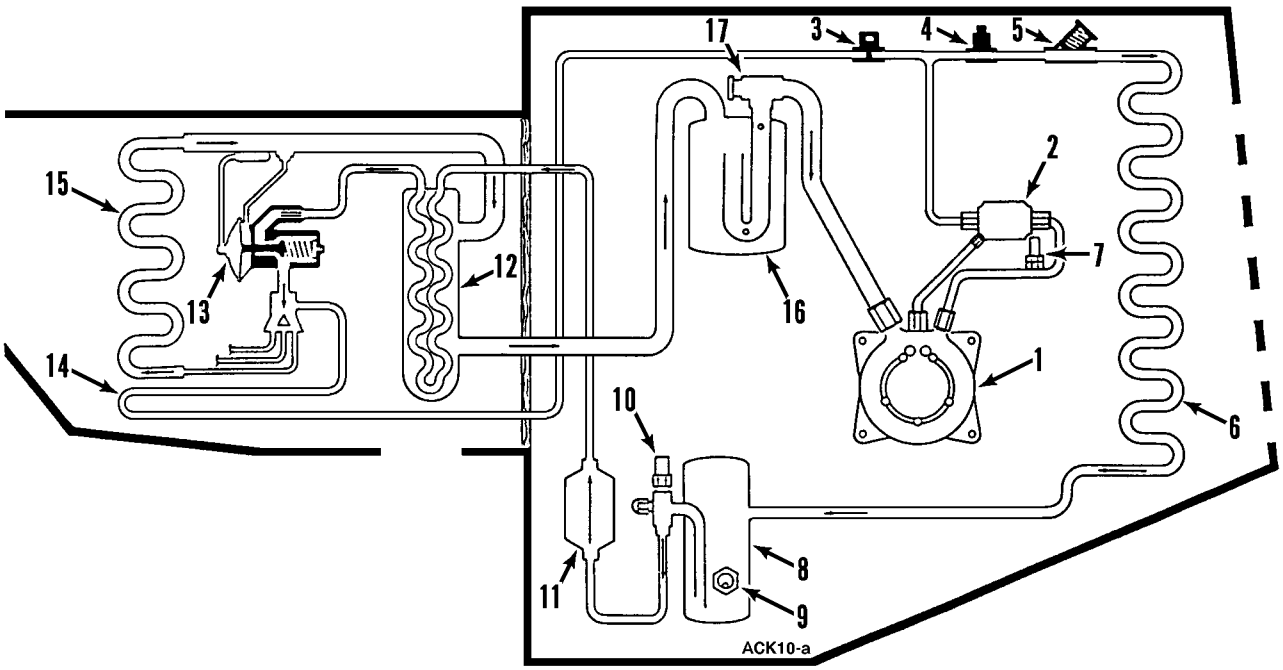
CONDITION	POSSIBLE CAUSE	REMEDY
Contact chatter	Low battery voltage	Check voltage condition. Check momentary voltage dip during starting—low voltage prevents magnet sealing
	Defective or incorrect coil	Replace coil
	Poor contact in control circuit	Check auxiliary switch contacts and overload relay contacts. Check for loose connections in control circuits
	Poor ground on PC board	Test ground circuit on PC board
	Defective thermostat relay	Check operation of thermostat relay
Contact welding or freezing	Abnormal in-rush of current	Check or grounds, shorts or excessive motor load current
	Low voltage	Correct voltage condition. Check momentary voltage dip during starting
	Foreign matter prevents contacts from closing	Clean contacts
	Rapid cycling	Check for cause of short cycling (such as thermostat)
	Short circuit	Correct fault
Electric heaters do not heat—(optional) indicator lights come on	Defective heater contactor	Replace contactor
	26 wire open	Locate open and repair
	Defective HIGH TEMPERATURE switch or sensor	Replace switch or sensor
Battery is not recharging	Loose connections in electrical system	Check all electrical connections and charging system
	Worn brushes in alternator	Replace brushes
	Voltage regulator faulty	Repair or replace regulator
	Battery defective	Replace battery
	Alternator defective	Repair or replace alternator
	Loose belt	Tighten belt
	Dirty battery terminals	Clean and retighten

Refrigeration Diagnosis Chart

Rapid cycling between cool and heat	Unit cools in Heat and Defrost cycle	Unit heats in Refrigeration cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or defrosting	SYMPTOM / POSSIBLE CAUSES
			•			•									•	•		Overcharge of refrigerant
				•			•		•	•						•	•	Shortage of refrigerant
				•				•	•							•	•	No refrigerant
			•															Air through condenser too hot (ambient)
			•															Air flow through condenser restricted
				•			•			•								Air through condenser too cold (ambient)
			•												•	•		Air in refrigerant system
			•															Condenser fan blades bent or broken
•																		Air short cycling around evaporator coil
							•											Air through evaporator restricted
							•		•		•				•			Evaporator needs defrosting
				•									•					Compressor discharge valves leaking
						•						•						Compressor suction valves leaking
																•		Too much compressor oil in system
															•			Faulty oil pump in compressor
															•			Loose compressor pulley
															•			Compressor bearing loose or burned out
				•								•	•	•	•			Broken valve plate in compressor
							•									•		Expansion valve power element lost its charge
						•					•							Expansion valve feeler bulb improperly mounted

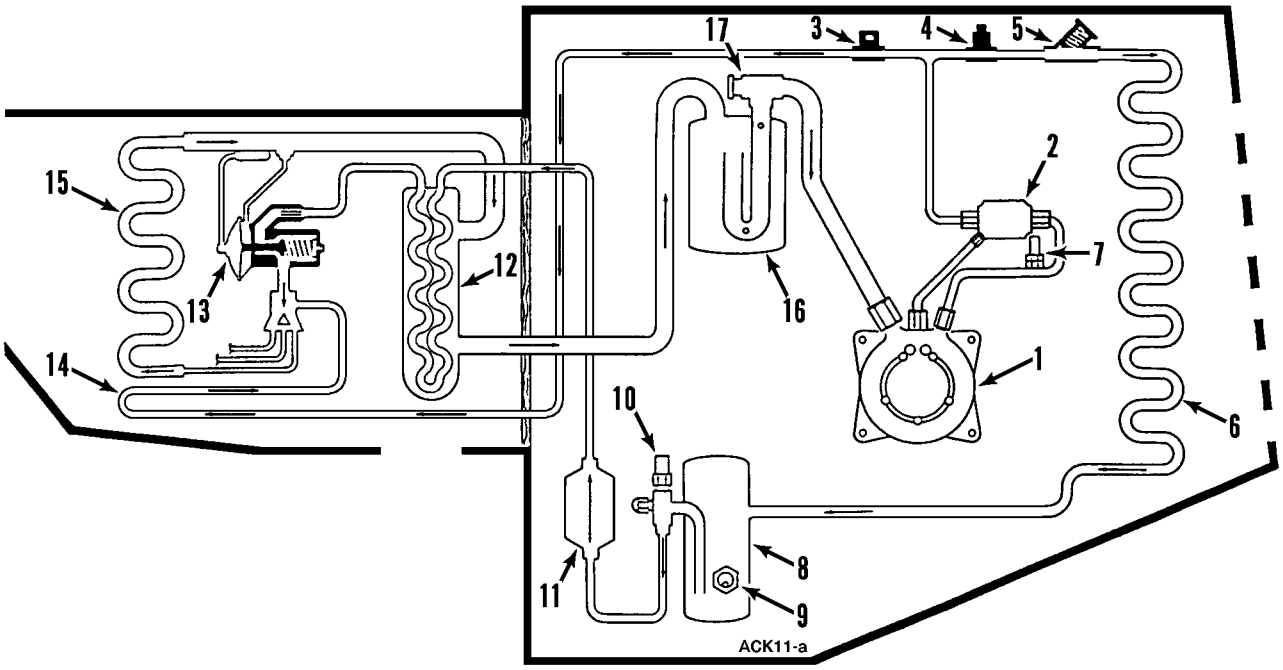
Rapid cycling between cool and heat	Unit cools in Heat and Defrost cycle	Unit heats in Refrigeration cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or defrosting	**SYMPTOM** / **POSSIBLE CAUSES**
						•					•					•		Expansion valve feeler bulb making poor contact
						•					•							Expansion valve open too much
							•									•		Expansion valve closed too much
						•					•							Expansion valve needle eroded or leaking
							•		•							•		Expansion valve partially closed by ice, dirt or wax
						•					•				•			Liquid refrigerant entering compressor
							•		•									Restricted line on the low side
			•				•		•							•		Restricted line on the high side
			•				•		•							•		Restricted drier
																	•	Evaporator shutter open
							•		•							•		Evaporator shutter stuck closed
					•													Discharge service valve back seated
								•										Suction service valve back seated
	•	•		•		•						•		•			•	Faulty three-way valve
	•	•										•				•	•	Faulty pilot solenoid
	•																•	Loose or broken electrical connections
•						•	•		•							•		Thermostat or thermometer out of calibration
						•	•	•	•									Suction pressure gauge out of calibration
												•						Leaky receiver tank outlet valve
												•						Leaky bypass check valve
						•	•					•				•	•	Leaky condenser check valve

Refrigeration Diagrams



Cool Mode

1.	Compressor	10.	Receiver Outlet Valve
2.	Oil Separator	11.	Drier
3.	Hot Gas Solenoid	12.	Heat Exchanger
4.	Liquid Line Solenoid	13.	Expansion Valve
5.	Condenser Inlet Check Valve	14.	Pan Heater
6.	Condenser Coil	15.	Evaporator Coil
7.	High Pressure Relief Valve	16.	Accumulator Tank
8.	Receiver Tank	17.	Suction Pressure Regulator
9.	Sight Glass		

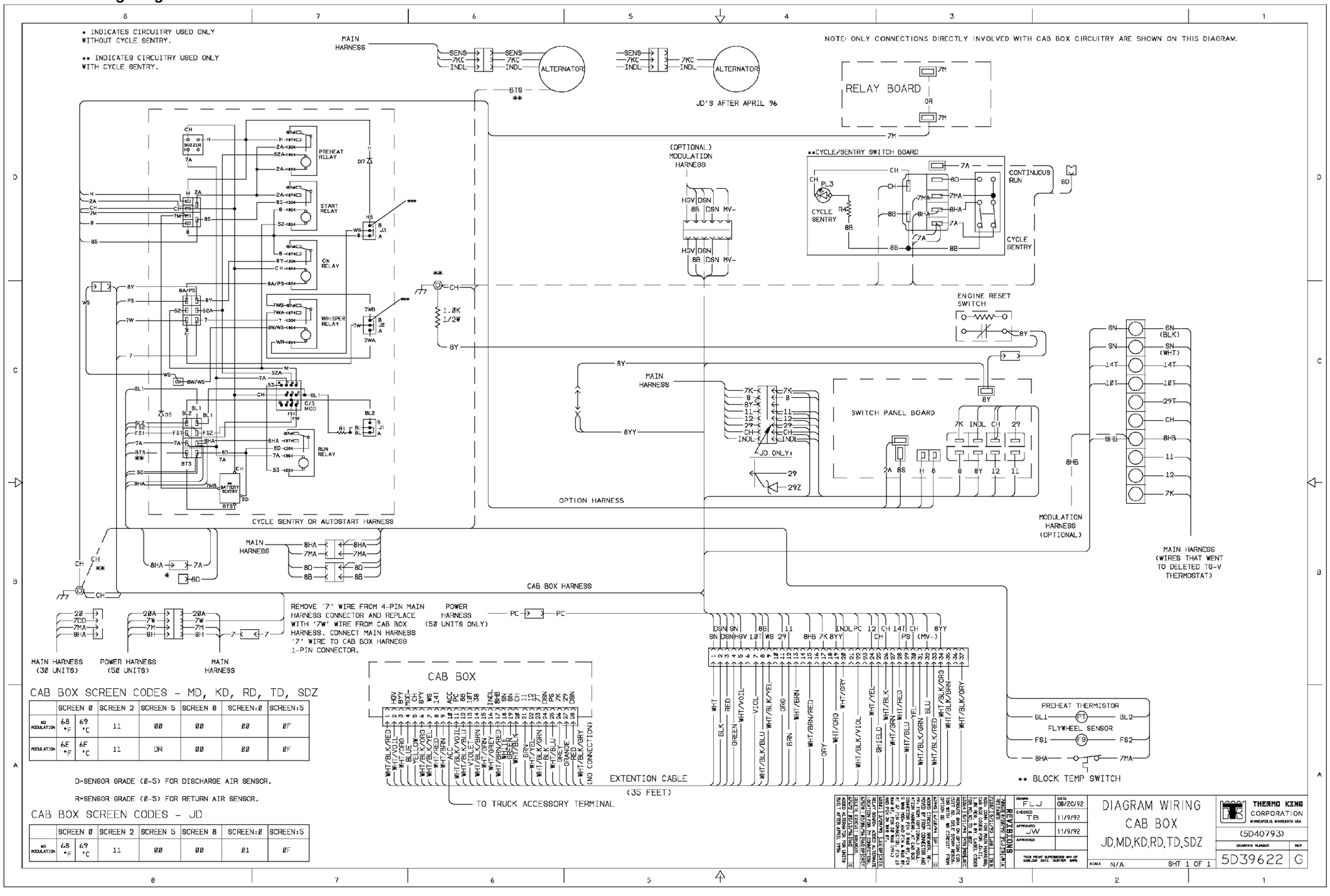


Heat and Defrost Modes

1.	Compressor	10.	Receiver Outlet Valve
2.	Oil Separator	11.	Drier
3.	Hot Gas Solenoid	12.	Heat Exchanger
4.	Liquid Line Solenoid	13.	Expansion Valve
5.	Condenser Inlet Check Valve	14.	Pan Heater
6.	Condenser Coil	15.	Evaporator Coil
7.	High Pressure Relief Valve	16.	Accumulator Tank
8.	Receiver Tank	17.	Suction Pressure Regulator
9.	Sight Glass		

Wiring Diagrams and Schematic Index

Cab Box Wiring Diagram



CAB BOX SCREEN CODES - MD, KD, RD, TD, SDZ

	SCREEN Ø		SCREEN 2	SCREEN 5	SCREEN 8	SCREEN:Ø	SCREEN:5
NO MODULATION	68 °F	69 °C	11	ØØ	ØØ	ØØ	ØF
MODULATION	6F °F	6F °C	11	DR	ØØ	ØØ	ØF

D=SENSOR GRADE (Ø-5) FOR DISCHARGE AIR SENSOR.

R=SENSOR GRADE (Ø-5) FOR RETURN AIR SENSOR.

CAB BOX SCREEN CODES - JD

	SCREEN Ø		SCREEN 2	SCREEN 5	SCREEN 8	SCREEN:Ø	SCREEN:5
NO MODULATION	68 °F	69 °C	11	ØØ	ØØ	Ø1	ØF

DRAWN	FLJ	08/20/92
CHECKED	TB	11/9/92
APPROVED	JW	11/9/92
APPROVED		

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DIAGRAM WIRING CAB BOX JD,MD,KD,RD,TD,SDZ

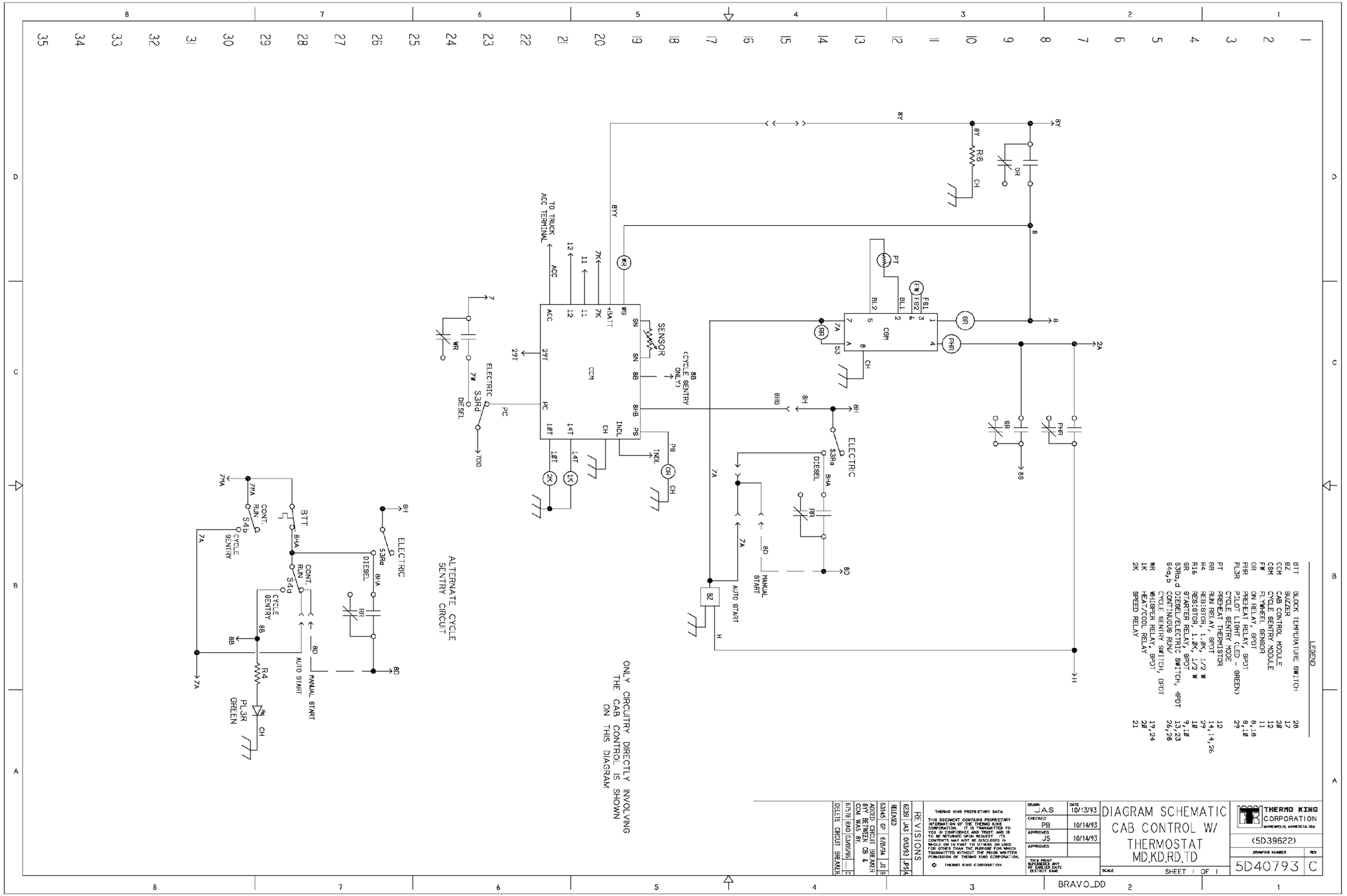
THERMO KING CORPORATION MINNEAPOLIS, MINNESOTA USA

(5D40793)

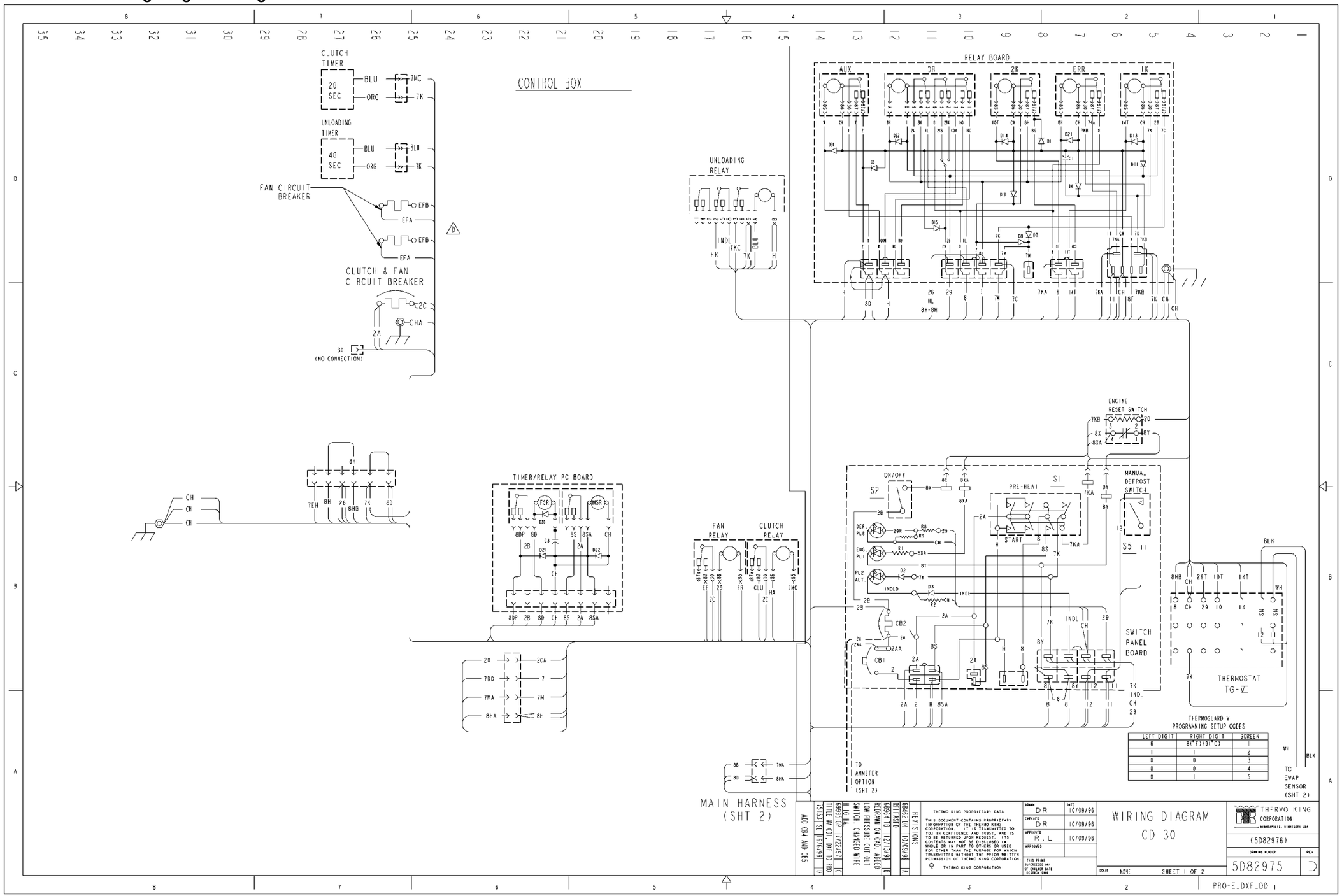
DRAWING NUMBER	REV
5D39622	G

SCALE N/A SHT 1 OF 1

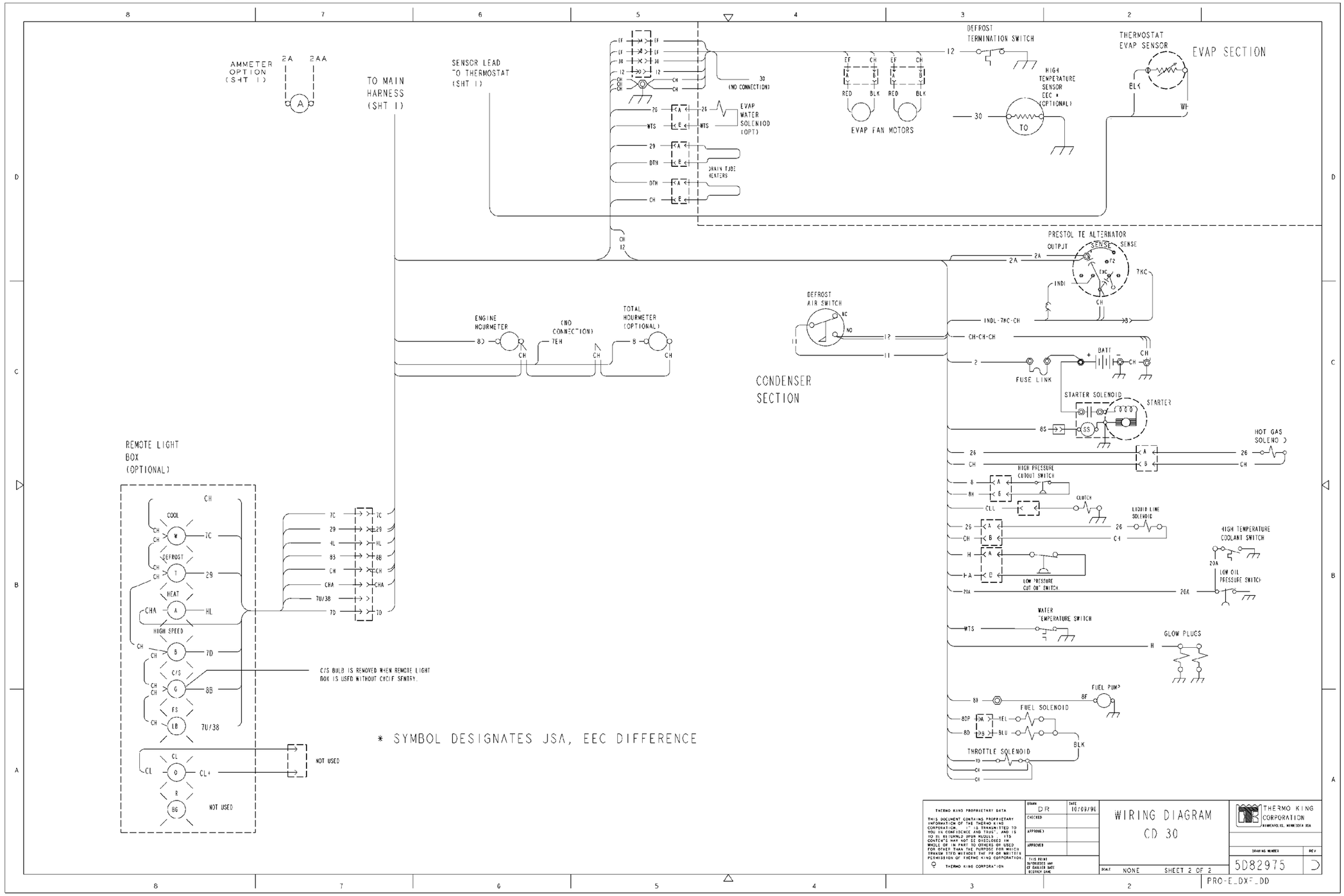
Cab Control Schematic Diagram



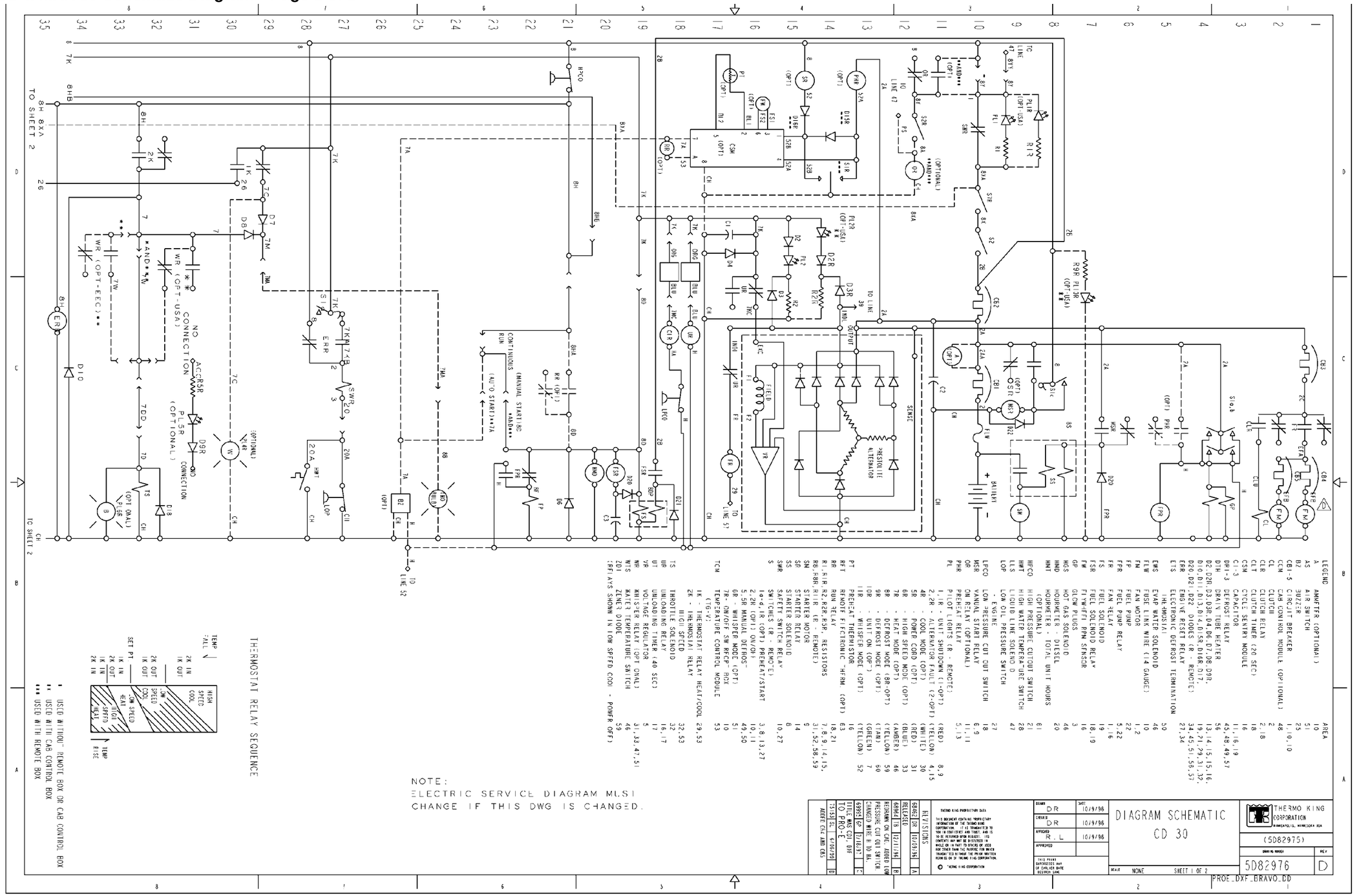
CD-II MAX 30 Wiring Diagram—Page 1 of 2



CD-II MAX 30 EEC Wiring Diagram—Page 2 of 2



CD-II MAX 30 Schematic Diagram—Page 1 of 2



LEGEND

		AREA
A	AMMETER (OPTIONAL)	10
AS	AIR SWITCH	51
BZ	BUZZER	25
CB1-5	CIRCUIT BREAKER	1,10,10
CCM	CAM CONTROL MODULE (OPTIONAL)	48
CL	CLUTCH	2
CLR	CLUTCH RELAY	2,18
CLT	CLUTCH TIMER (20 SEC)	18
CSM	CYCLE SENTRY MODULE	16
C1-3	CAPACITOR	11,16,19
DFI-3	DEFROST RELAY	45,48,49,57
DTH	DRAIN TUBE HEATER	56
D2,D2R,D3,D3R,D4,D6,D7,D8,D9R,		13,14,15,15,16,
D10,D11,D13,D14,D15R,D16R,D17,		19,21,29,31,32,
D20,D21,D22	DIODES (R - REMOTE)	34,45,51,56,57
EFBR	ENGINE RESET RELAY	27,34
ETS	ELECTRONIC DEFROST TERMINATION (THERMISTA)	50
EWS	EVAP WATER SOLENOID	46
FLW	FUSE LINK WIRE (14 GAUGE)	10
FM	FAN MOTOR	10
FP	FUEL PUMP	1,2
FPR	FUEL PUMP RELAY	22
FR	FAN RELAY	5,22
FS	FUEL SOLENOID	1,16
FSR	FUEL SOLENOID RELAY	19
FW	FLYWHEEL RPM SENSOR	18,19
GP	GLOW PLUGS	16
HGS	HOT GAS SOLENOID	3
HMD	HOURMETER - DIESEL	46
HMT	HOURMETER - TOTAL UNIT HOURS (OPTIONAL)	20
HPCO	HIGH PRESSURE CUTOUT SWITCH	61
HWT	HIGH WATER TEMPERATURE SWITCH	21
LLS	LIQUID LINE SOLENOID	28
LOP	LOW OIL PRESSURE SWITCH - ENGINE	47
LPCO	LOW PRESSURE CUT OUT SWITCH	27
MSR	MANUAL START RELAY	18
OR	ON RELAY (OPTIONAL)	6,9
PHR	PREHEAT RELAY	11,11
PL	PILOT LIGHTS (R - REMOTE): 1,1R - UNIT SHUTDOWN (1-OPT) (RED)	5,13 8,9
	2,2R - ALTERNATOR FAULT (2-OPT) (YELLOW)	4,15
5R	- COOL MODE (OPT) (WHITE)	30
6R	- POWER CORD (OPT) (RED)	31
7R	- HIGH SPEED MODE (OPT) (BLUE)	33
8R	- DEFROST MODE (OPT) (AMBER)	43
9R	- DEFROST MODE (8R-OPT) (YELLOW)	56
10R	- UNIT ON (OPT) (GREEN)	59
11R	- WHISPER MODE (OPT) (GREEN)	7
PT	PRESET THERMISTOR (YELLOW)	52
RFT	REMOTE FIXTRONIC THERM. (OPT)	16
RR	RUN RELAY	63
R1,R1R,R2,R2R,R5R	RESISTORS	18,21
R6,R6R,R11R	(R - REMOTE)	7,8,9,14,15,
SM	STARTER MOTOR	31,52,58,59
SR	STARTER RELAY	9
SS	STARTER SOLENOID	14
SWR	SAFETY SWITCH RELAY	6
S	SWITCHES (R - REMOTE): 1a-c,1R (OPT) PREHEAT/START	10,27 3,8,13,27
	2,2R (OPT) ON/OFF	10,11
	5,5R MANUAL DEFROST	49,50
	7R - ON/OFF SW RECP BOX	51
	8R - WHISPER MODE (OPT)	10
TCM	TEMPERATURE CONTROL MODULE (-TG-V)	53
	1K - THERMOSTAT RELAY HEAT/COOL	29,53
	2K - THERMISTA RELAY	32,53
TS	THROTTLE SOLENOID	32,53
UR	UNLOADING RELAY	16,17
UT	UNLOADING TIMER (40 SEC)	17
VR	VOLTAGE REGULATOR	5
WHS	WHISPER RELAY (OPTIONAL)	31,33,47,51
WTS	WATER TEMPERATURE SWITCH	46
ZD1	ZENER DIODE	59

(OPTIONALS SHOWN IN LOW SPEED COOL - POWER OFF)

NOTE:
ELECTRIC SERVICE DIAGRAM MLSI
CHANGE IF THIS DWG IS CHANGED.

REVISIONS			
69862 JGR	10/09/96	A
RELEASED		
69864 TB	10/11/96	B
REDRAWN ON CAD. ADDED LOW PRESSURE CUT OUT SWITCH CONNECTION MORE R TO MA.		
69895 GP	12/18/97	C
TITLE WAS CD1, DSI TO PRO-E		
73531 SL	6/09/98	D
ADDED CS4 AND CB5		

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CHECKED	DR	10/9/96
APPROVED	R. L	10/9/96
APPROVED		

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DIAGRAM SCHEMATIC
CD 30

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

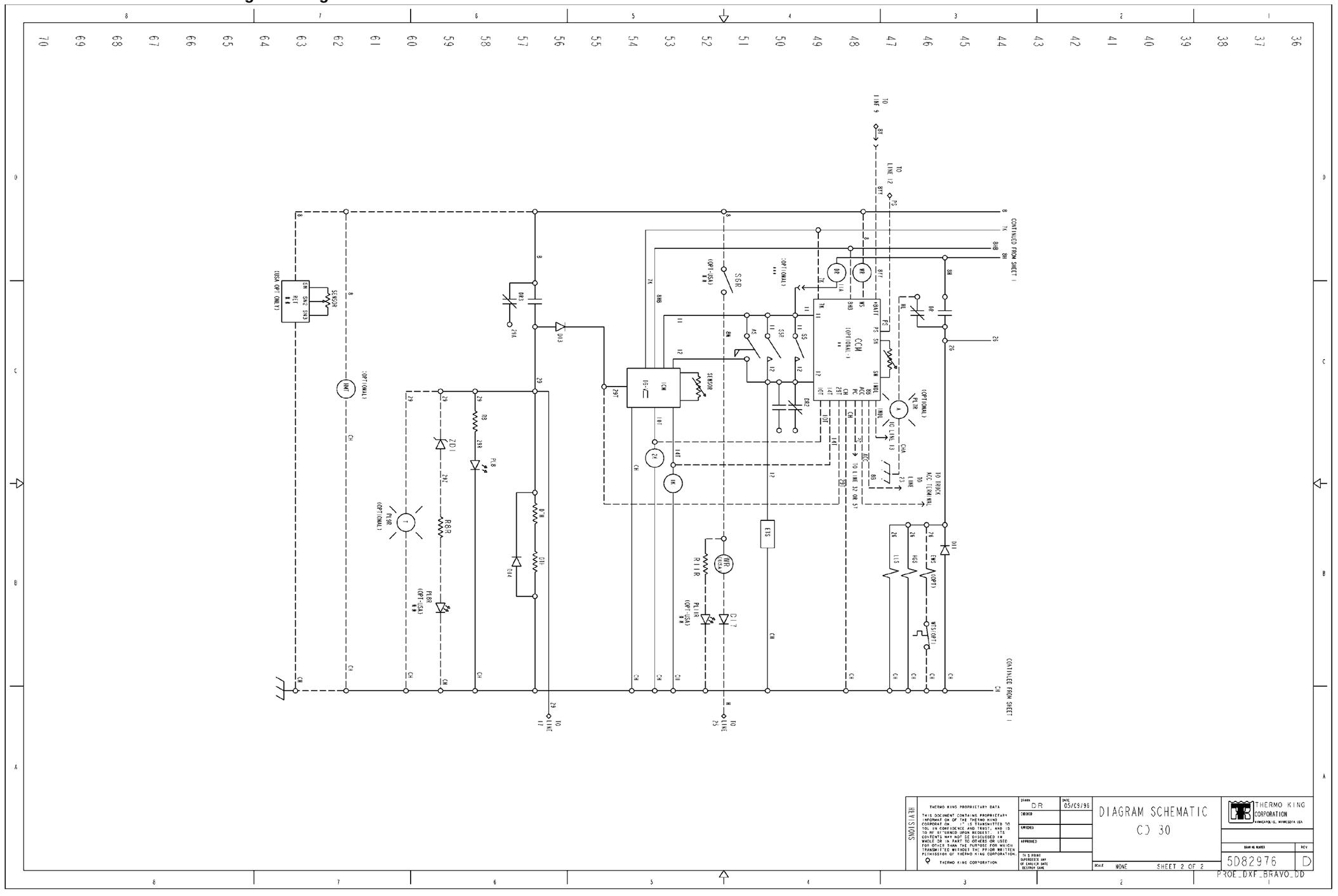
(5D82975)

DRAWING NUMBER: 5D82976 REV: D

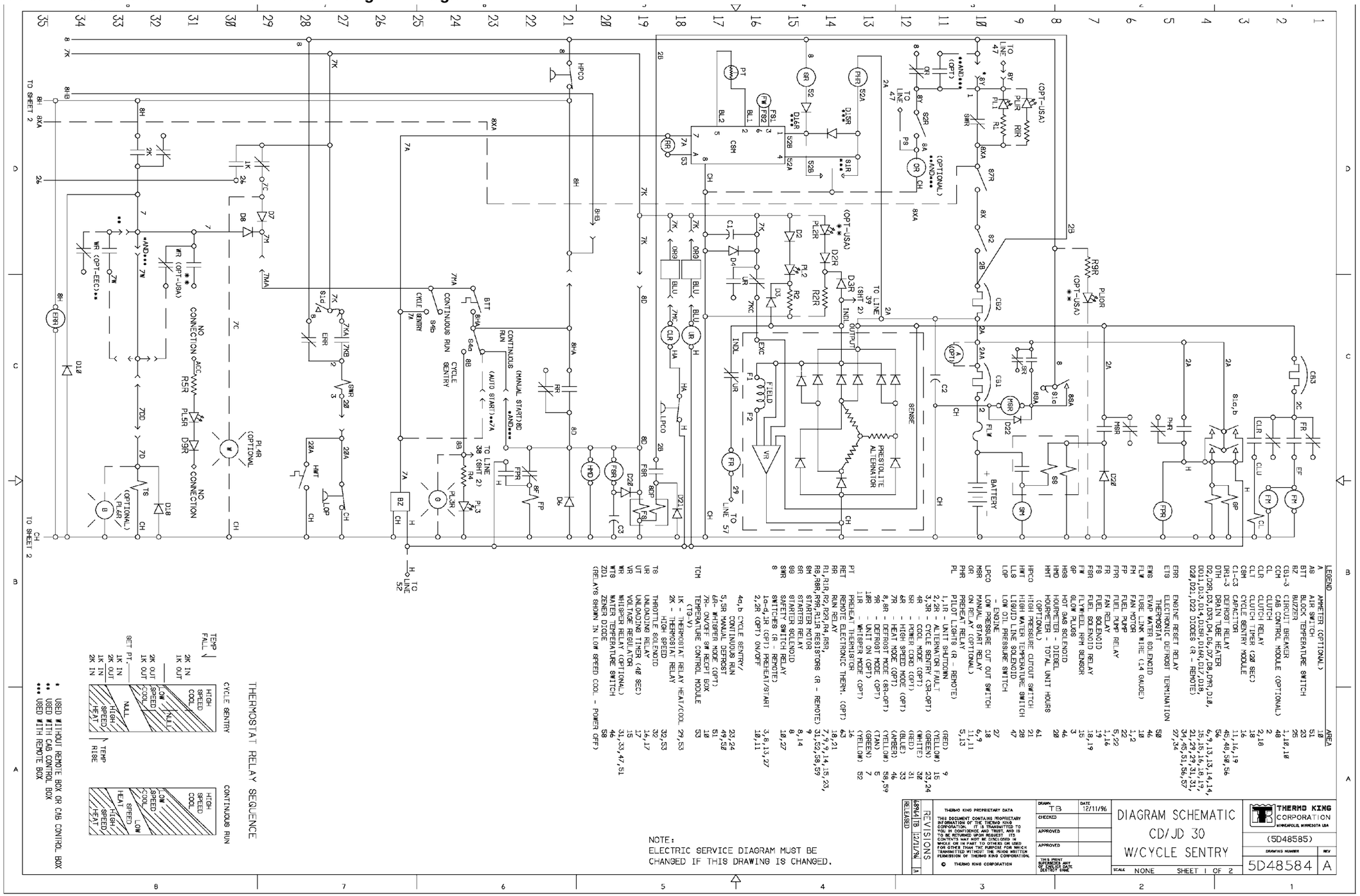
SCALE: NONE SHEET 1 OF 2

PROE_DXF_BRAVO_DD

CD-II MAX 30 EEC Schematic Diagram—Page 2 of 2



CD-II MAX 30 w/CYCLE-SENTRY Schematic Diagram—Page 1 of 2



LEGEND		AREA
A	AMMETER (OPTIONAL)	10
AS	AIR SWITCH	51
BTT	BLOCK TEMPERATURE SWITCH	23
BZ	BUZZER	25
CB1-3	CIRCUIT BREAKER	1,10,10
CCM	CAB CONTROL MODULE (OPTIONAL)	48
CL	CLUTCH	2
CLR	CLUTCH RELAY	18
CLT	CLUTCH TIMER (20 SEC)	18
CSM	CYCLE SENTRY MODULE	16
C1-C3	CAPACITOR	11,16,19
DFR1-3	DEFROST RELAY	56,48,58,56
DFT	DRAIN TUBE HEATER	56,48,58,56
D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12,D13,D14,D15,D16,D17,D18,D19,D20,D21,D22	DIODES (R - REMOTE)	6,9,13,14,14, 15,15,15,18,21, 21,29,29,31,31, 34,45,51,56,57, 27,34
ERR	ENGINE RESET RELAY	50
ETB	ELECTRONIC DEFROST TERMINATION THERMOSTAT	46
EWS	EVAP WATER SOLENOID	10
FLW	FUSE LINK WIRE (14 GAUGE)	1,2
FM	FAN MOTOR	22
FP	FUEL PUMP	5,22
FPR	FUEL PUMP RELAY	1,16
FR	FAN RELAY	19
FS	FUEL SOLENOID	18,19
FSR	FUEL SOLENOID RELAY	19
FW	FLYWHEEL RPM SENSOR	15
GP	GLOW PLUGS	3
HGS	HOT GAS SOLENOID	46
HMD	HOURMETER - DIESEL HOURMETER - TOTAL UNIT HOURS (OPTIONAL)	20
HPCO	HIGH PRESSURE CUTOUT SWITCH	41
HWT	HIGH WATER TEMPERATURE SWITCH	21
LLS	LIQUID LINE SOLENOID	28
LOP	LOW OIL PRESSURE SWITCH - ENGINE	47
LPCO	LOW PRESSURE CUT OUT SWITCH	27
MSR	MANUAL START RELAY	18
OR	ON RELAY (OPTIONAL)	6,9
PHR	PREHEAT RELAY	11,11
PL	PILOT LIGHTS (R - REMOTE)	5,13
L1R - UNIT SHUTDOWN	(RED)	9
2,2R - ALTERNATOR FAULT	(YELLOW)	15
3,3R - CYCLE SENTRY (3R-OPT)	(GREEN)	23,24
4R - COOL MODE (OPT)	(WHITE)	32
5R - POWER CORD (OPT)	(RED)	31
6R - HIGH SPEED MODE (OPT)	(BLUE)	33
7R - HEAT MODE (OPT)	(AMBER)	46
8,8R - DEFROST MODE (8R-OPT)	(YELLOW)	45,59
9R - DEFROST MODE (OPT)	(TAN)	6
10R - UNIT ON (OPT)	(GREEN)	7
L1R - WHISPER MODE (OPT)	(YELLOW)	52
PREHEAT THERMISTOR		16
PT		43
RET		18,21
RR	REMOTE ELECTRONIC THERM. (OPT)	7,9,9,14,15,23,
R1,R1R,R2,R2R,R4,R6Ω, R6,R8R,R9R,R11R	RESISTORS (R - REMOTE)	31,52,58,59
SM	STARTER MOTOR	9
SR	STARTER RELAY	8,14
SS	STARTER SOLENOID	8
SWR	SAFETY SWITCH RELAY	8,27
S	SWITCHES (R - REMOTE)	3,8,13,27
1a-d,1R (OPT)	PREHEAT/START 2,2R (OPT) ON/OFF	10,11
4a,b	CYCLE SENTRY/ CONTINUOUS RUN	23,24
5,5R	MANUAL DEFROST	45,52
7R	HEAT/OFF SW RECEPT BOX	18
TCM	TEMPERATURE CONTROL MODULE (TQ-V)	53
1K - THERMOSTAT RELAY HEAT/COOL		29,53
2K - THERMOSTAT RELAY - HIGH SPEED		32,53
TS	THROTTLE SOLENOID	32
UR	UNLOADING RELAY	16,17
UT	UNLOADING TIMER (40 SEC)	17
VR	VOLTAGE REGULATOR	15
WR	WHISPER RELAY (OPTIONAL)	31,33,47,51
WTS	WATER TEMPERATURE SWITCH	46
ZD1	ZENER DIODE (RELAYS SHOWN IN LOW SPEED COOL - POWER OFF)	58

NOTE:
ELECTRIC SERVICE DIAGRAM MUST BE CHANGED IF THIS DRAWING IS CHANGED.

REVISIONS		
RELEASED	TB	12/11/96

DRAWN	TB	DATE 12/11/96
CHECKED		
APPROVED		
APPROVED		

THIS PRINT SUPERCEDES ANY OF EARLIER DATE. DESTROY SAME.

DIAGRAM SCHEMATIC
CD/JD 30
W/CYCLE SENTRY

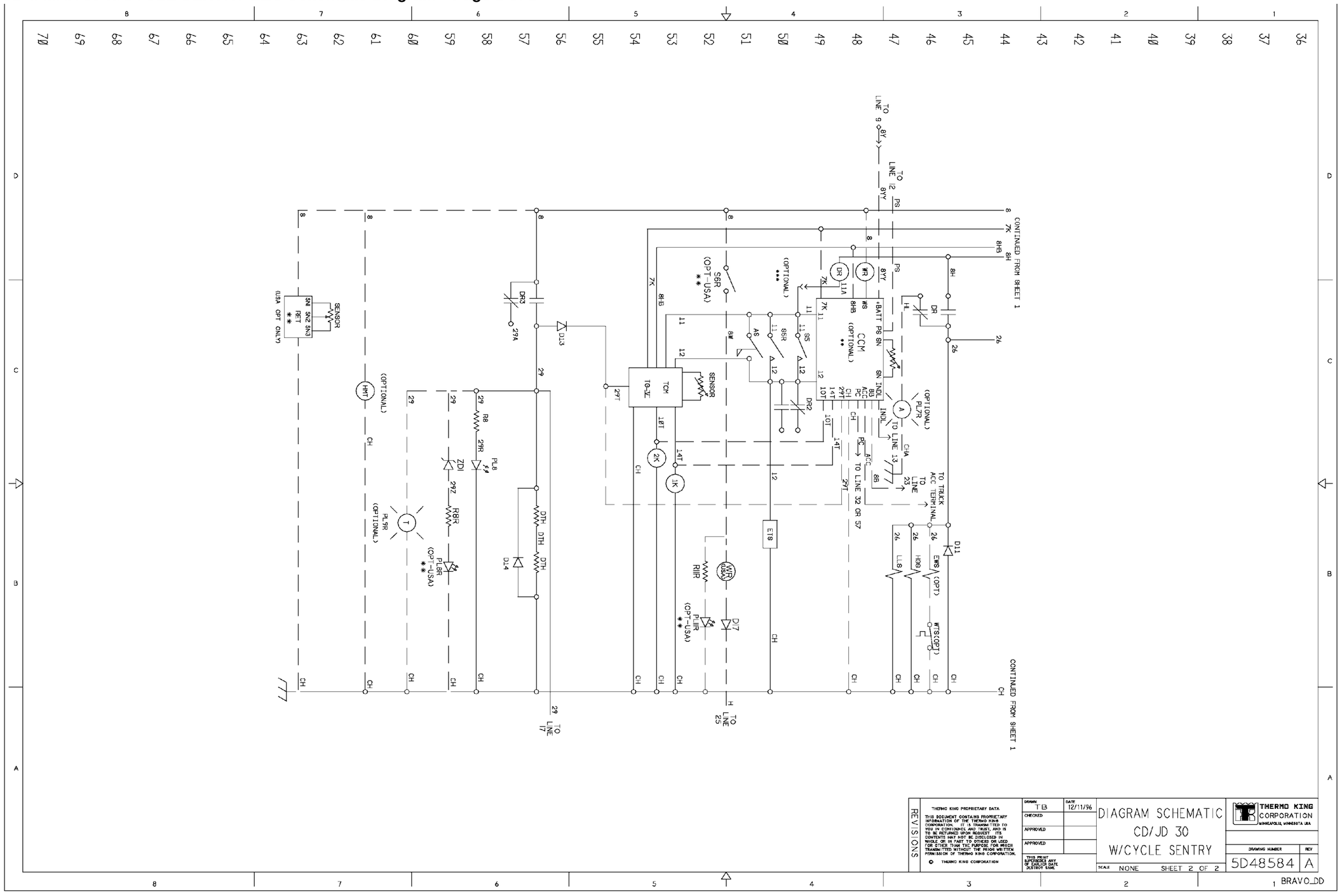
SCALE NONE SHEET 1 OF 2

THERMO KING CORPORATION
MINNEAPOLIS MINNESOTA USA

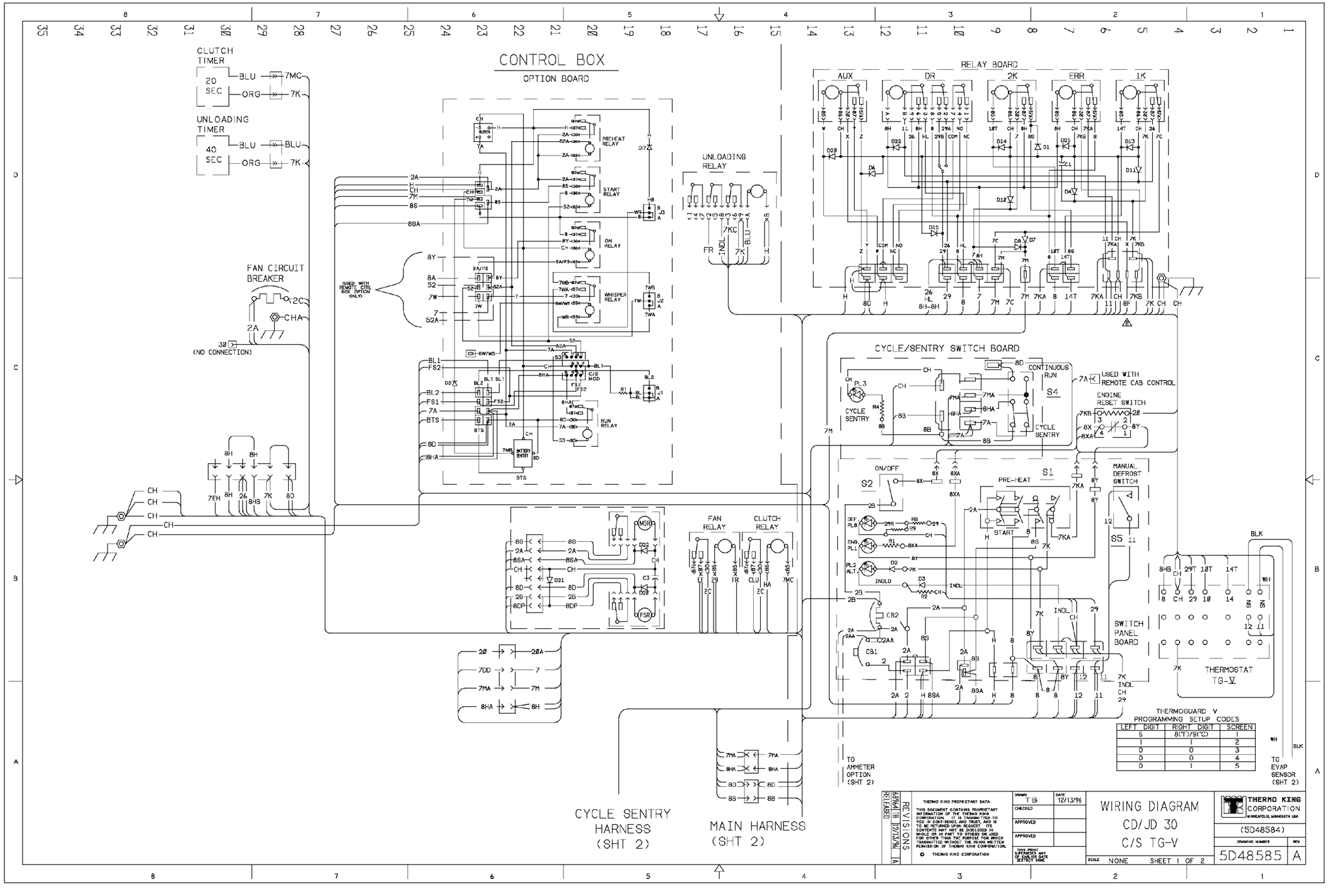
(5D48585)

DRAWING NUMBER 5D48584 REV A

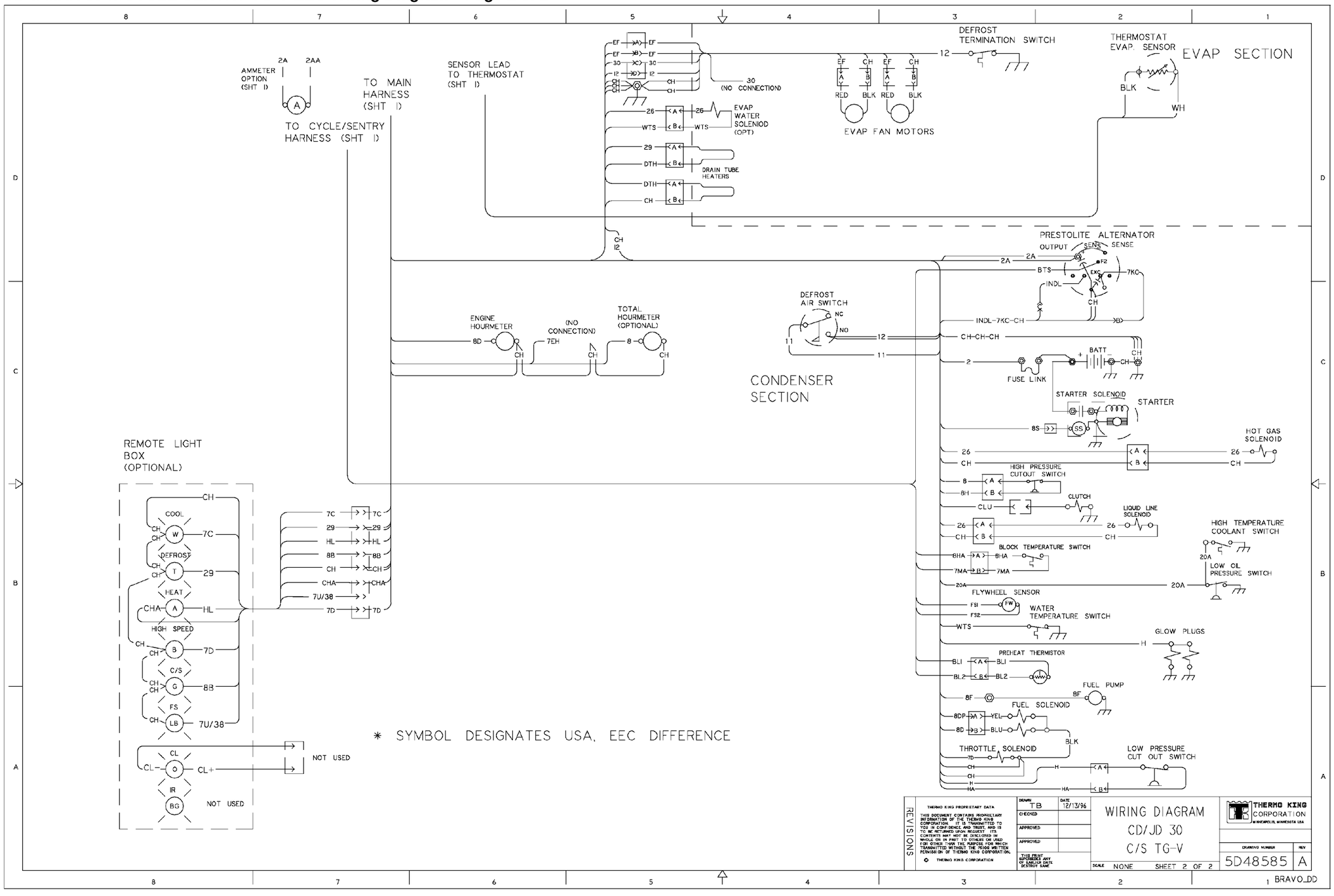
CD-II MAX 30 w/CYCLE SENTRY EEC Schematic Diagram—Page 2 of 2



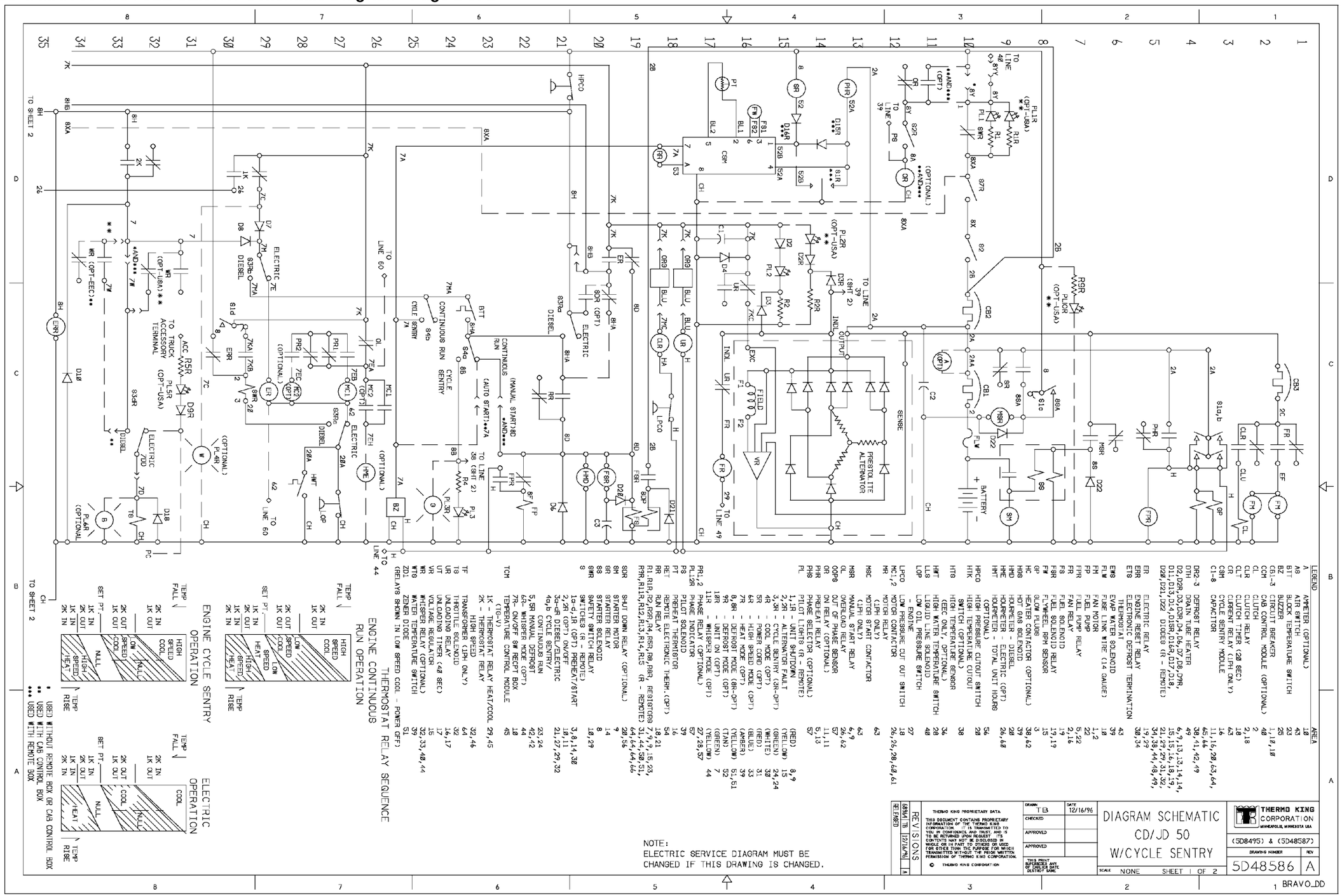
CD-II MAX 30 w/CYCLE SENTRY TG-V Wiring Diagram—Page 1 of 2



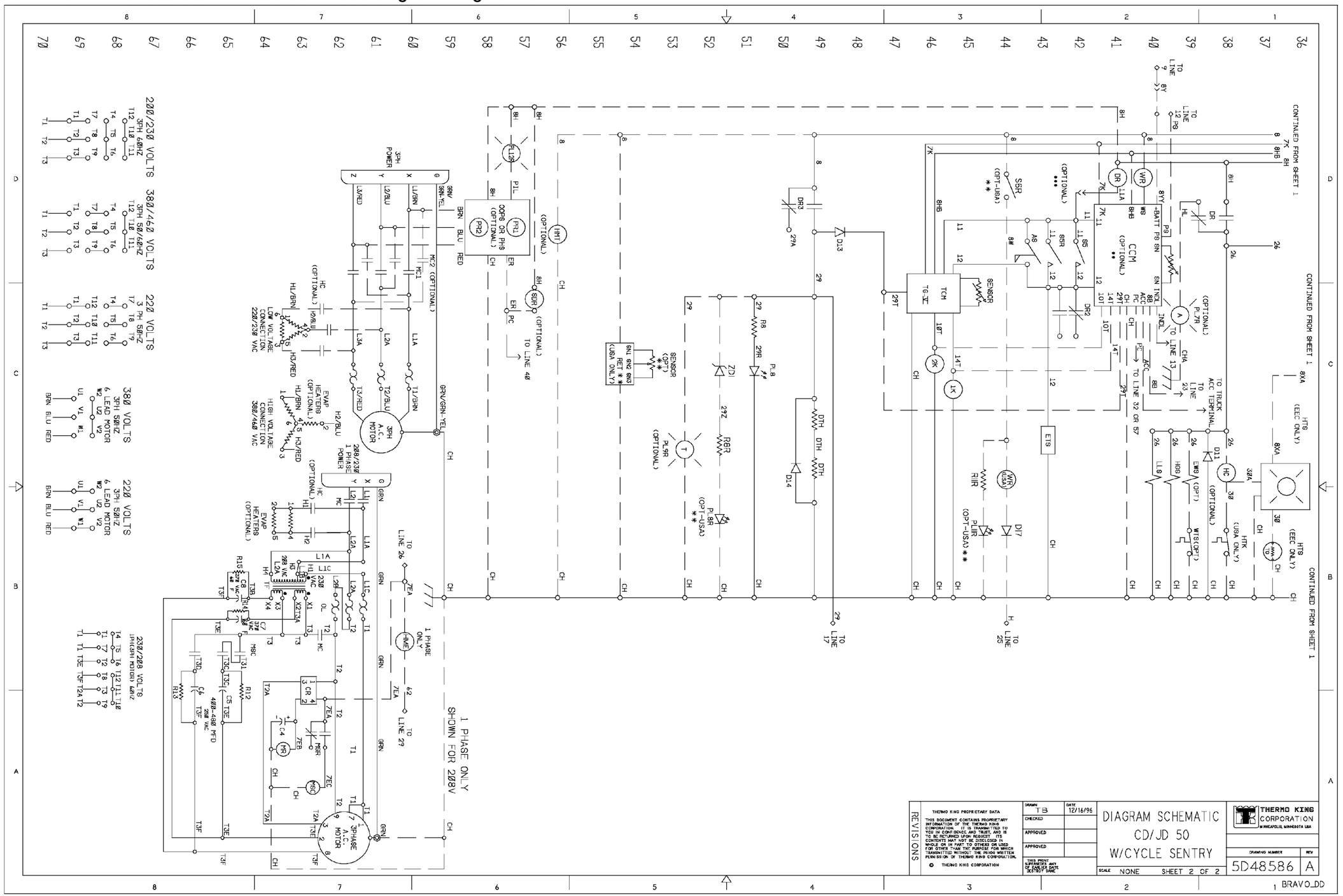
CD-II MAX 30 w/CYCLE SENTRY TG-V EEC Wiring Diagram—Page 2 of 2



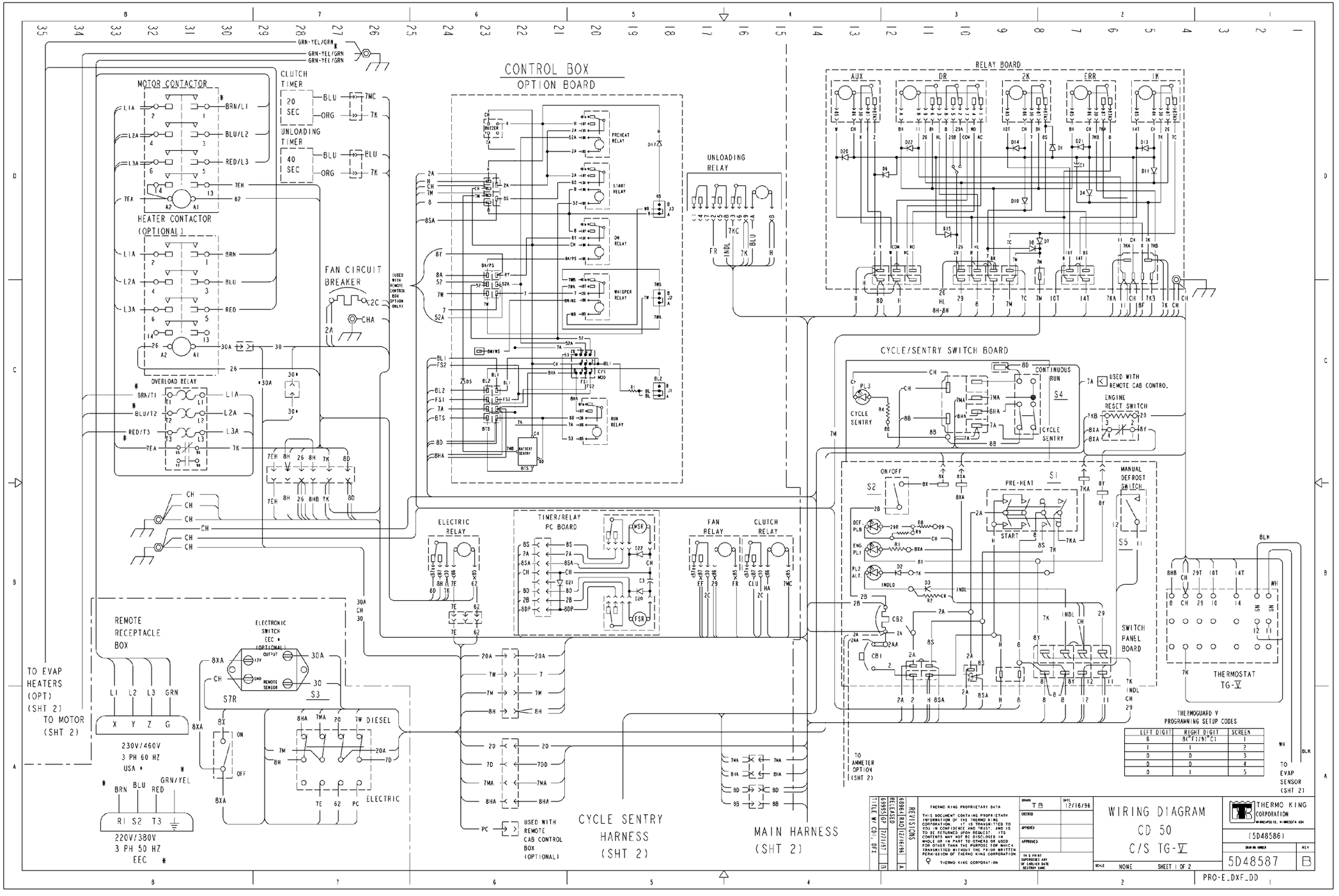
CD-II MAX 50 w/CYCLE SENTRY Schematic Diagram—Page 1 of 2



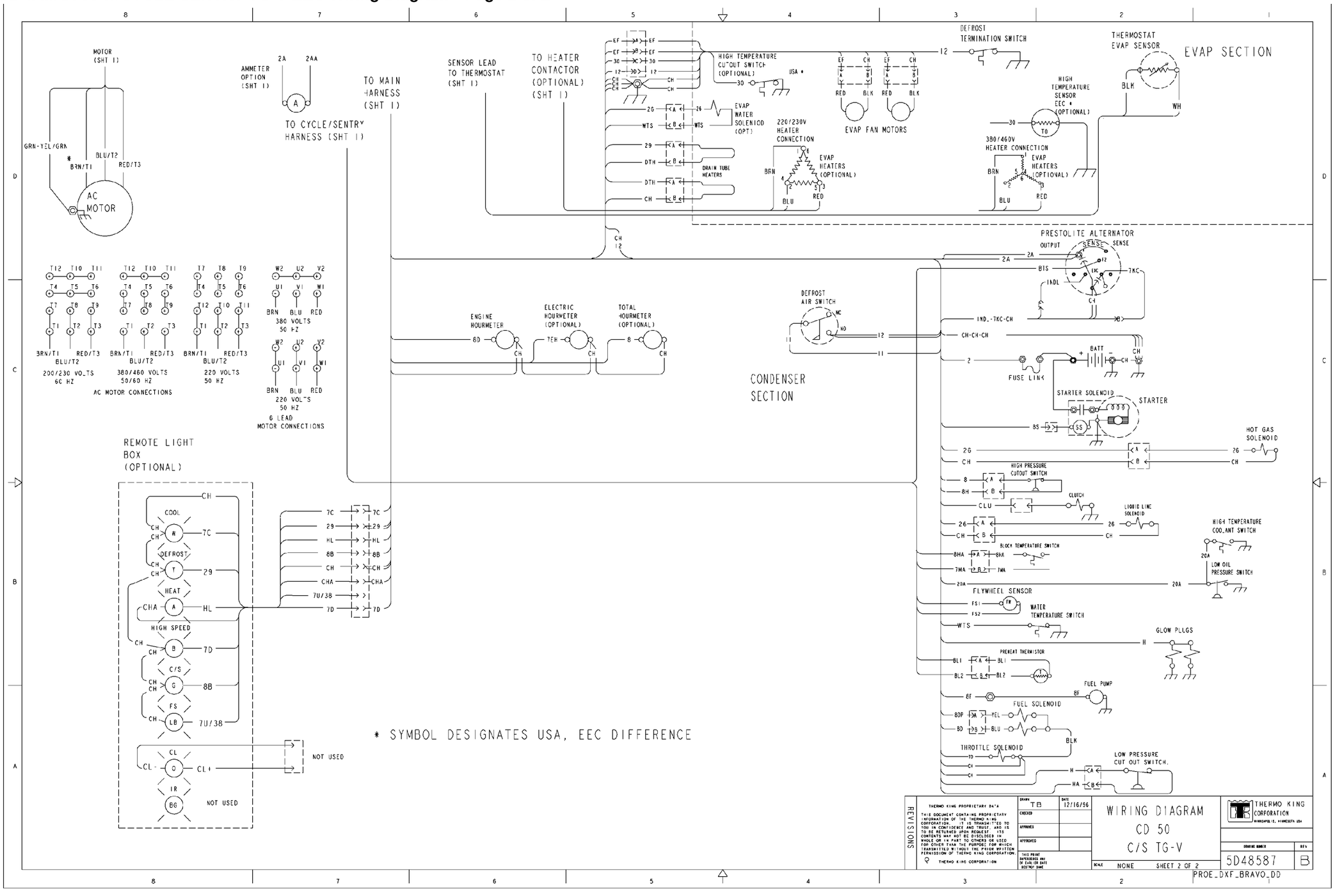
CD-II MAX 50 w/CYCLE SENTRY EEC Schematic Diagram—Page 2 of 2



CD-II MAX 50 w/CYCLE SENTRY TG-V Wiring Diagram—Page 1 of 2



CD-II MAX 50 w/CYCLE SENTRY TG-V EEC Wiring Diagram—Page 2 of 2



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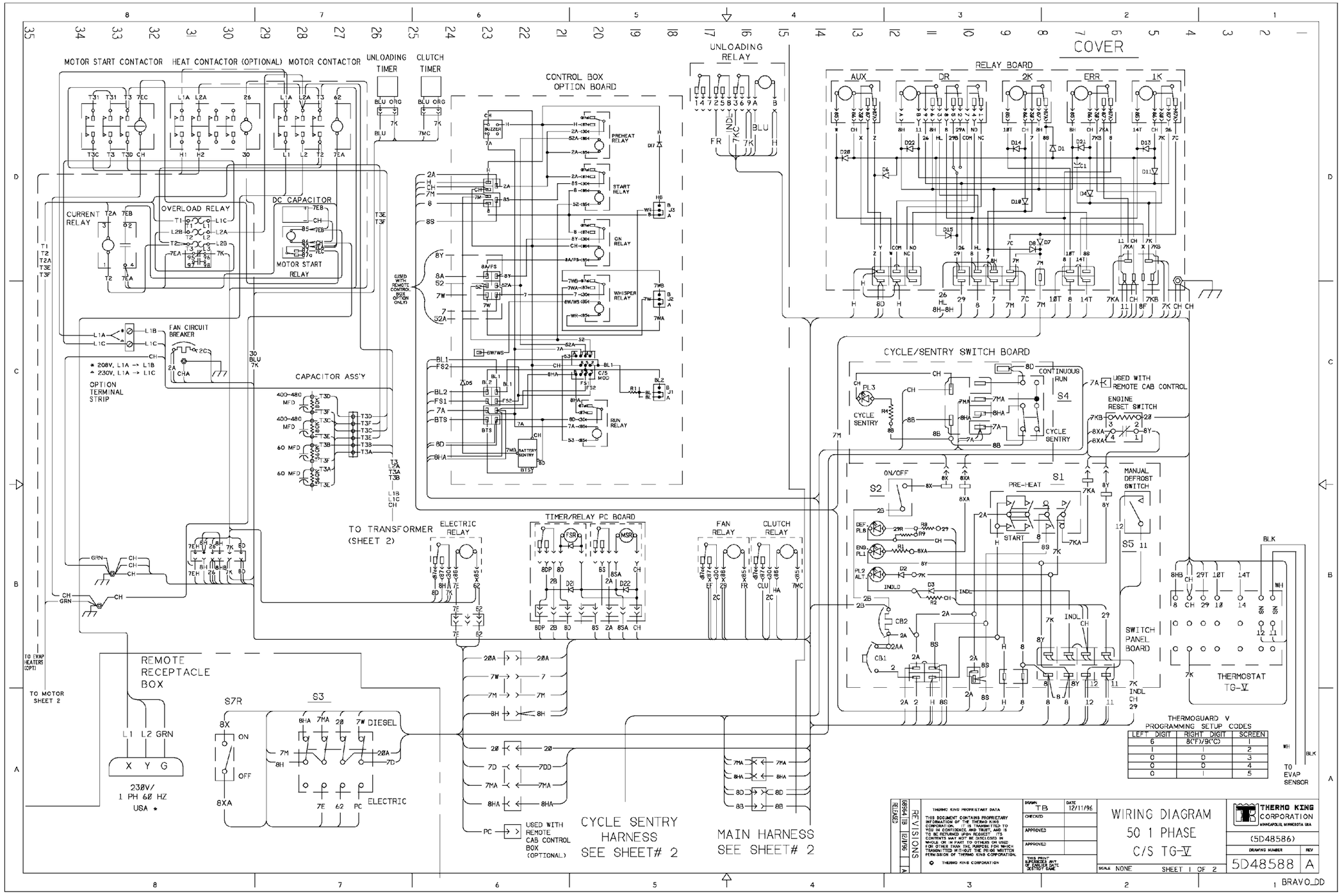

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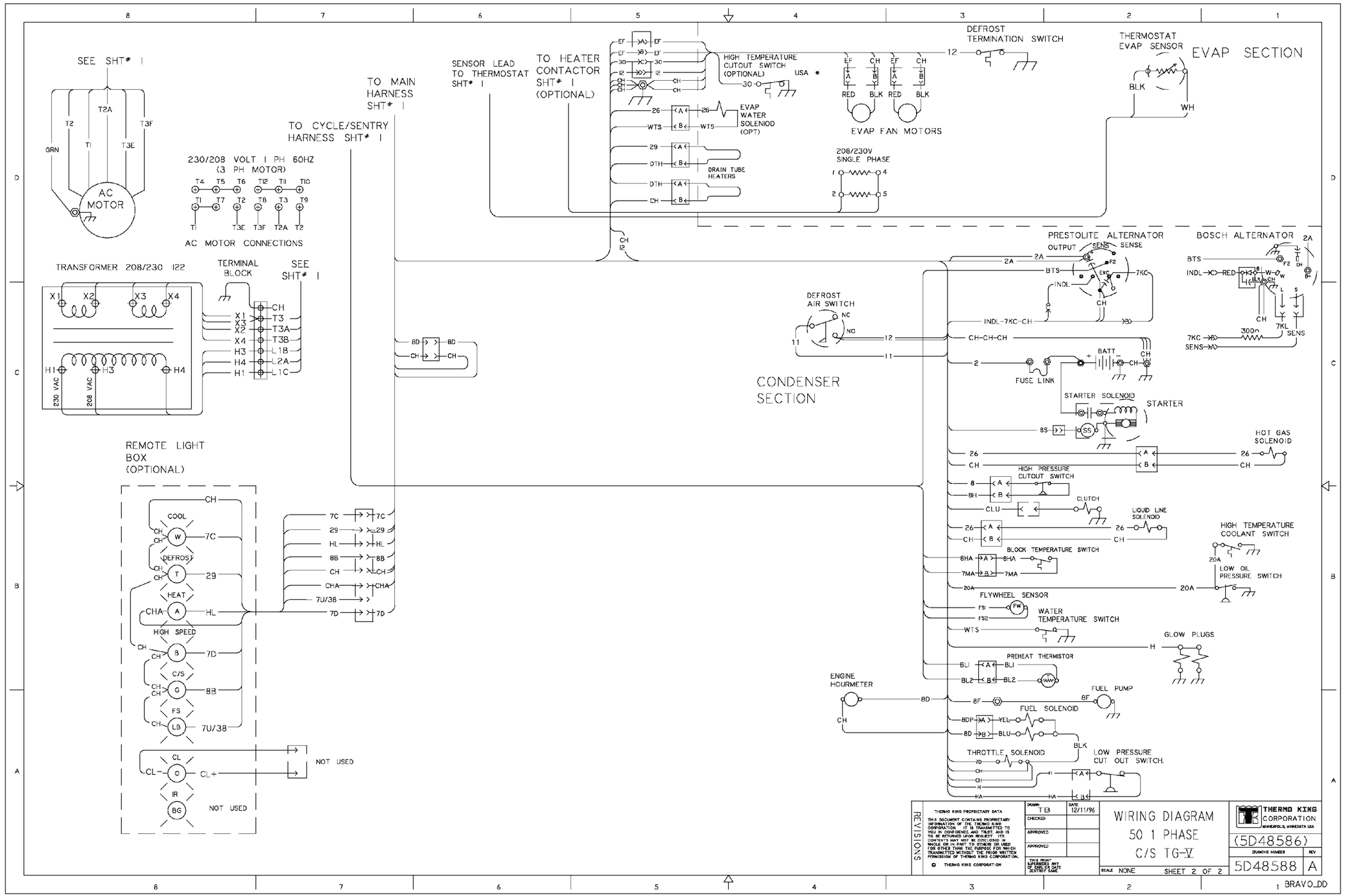
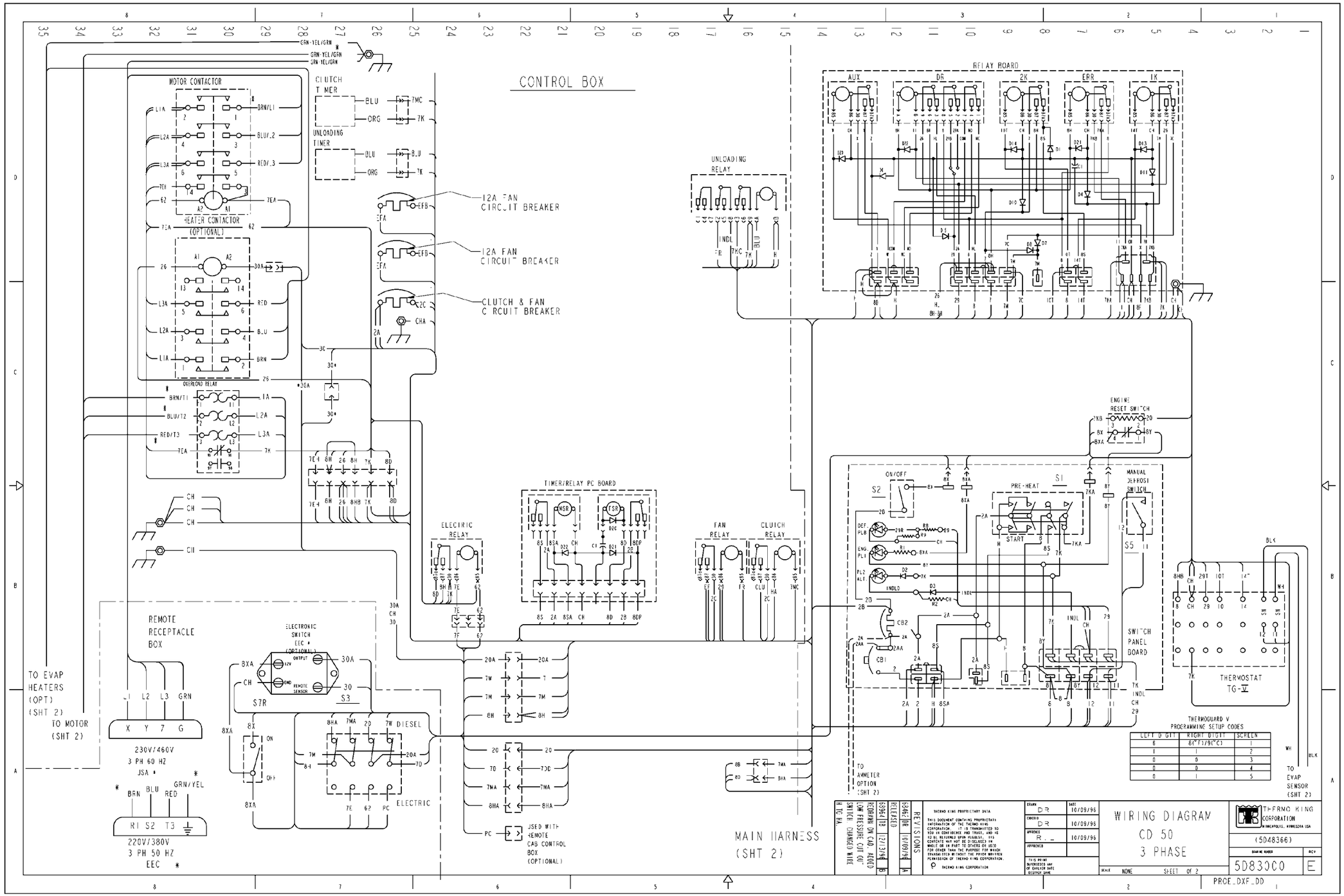
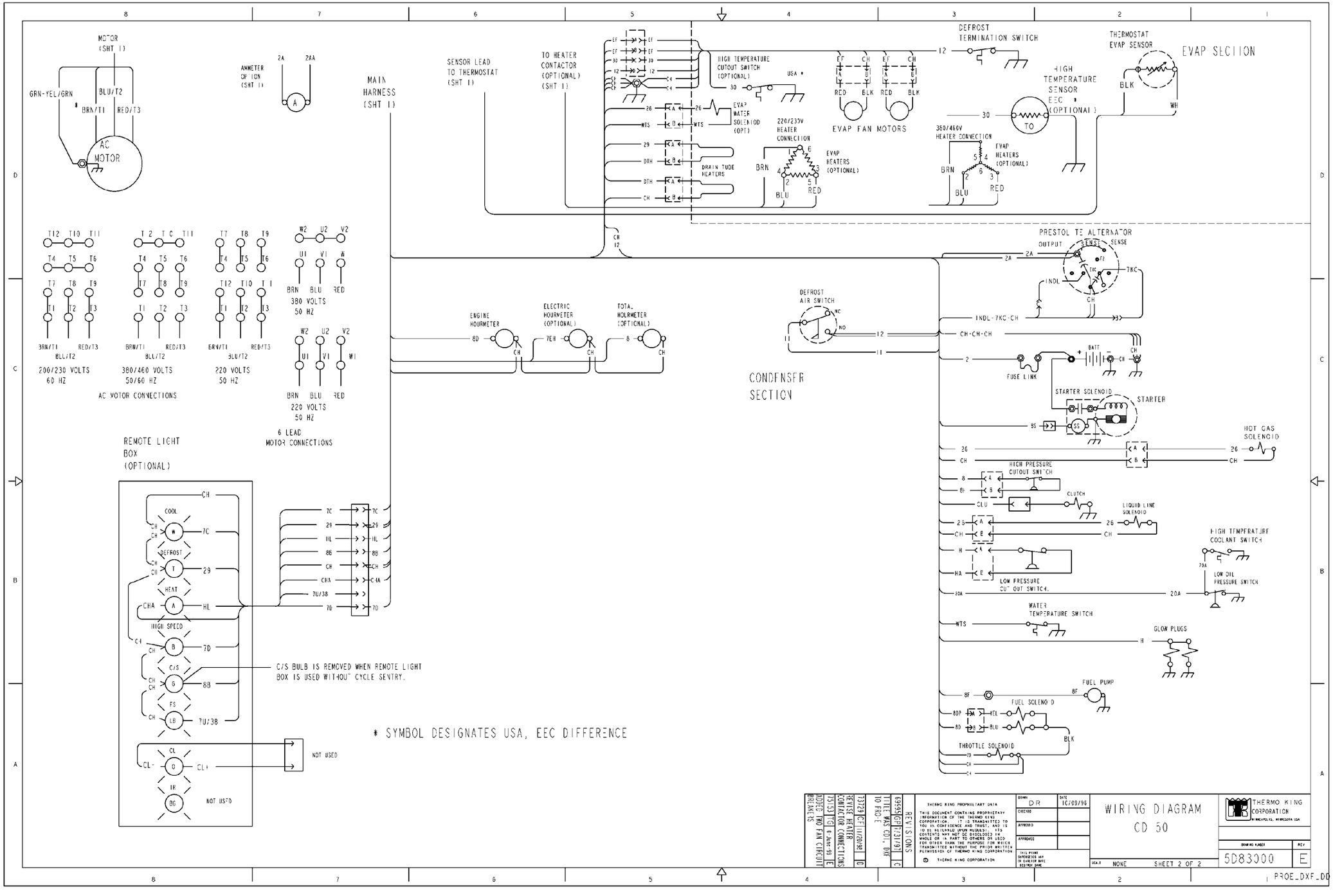


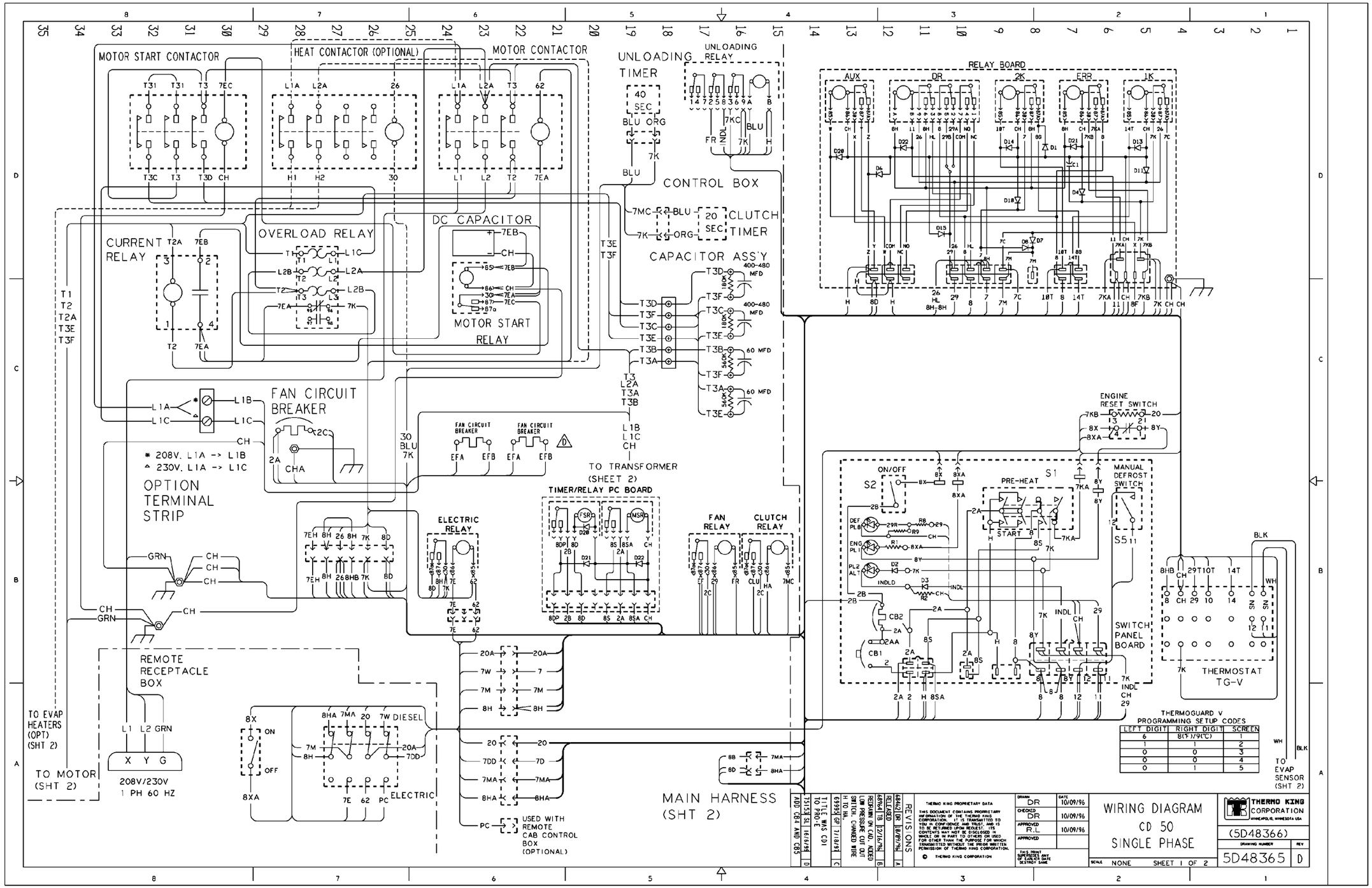
CD-II MAX 50 230/1/60, 230/3/60 Wiring Diagram—Page 1 of 2



CD-II MAX 50 220/3/60 EEC, 230/3/60 EEC, 380/3/60 EEC Wiring Diagram—Page 2 of 2



CD-II MAX 50 230/1/60, 230/3/60 Schematic Diagram—Page 1 of 2



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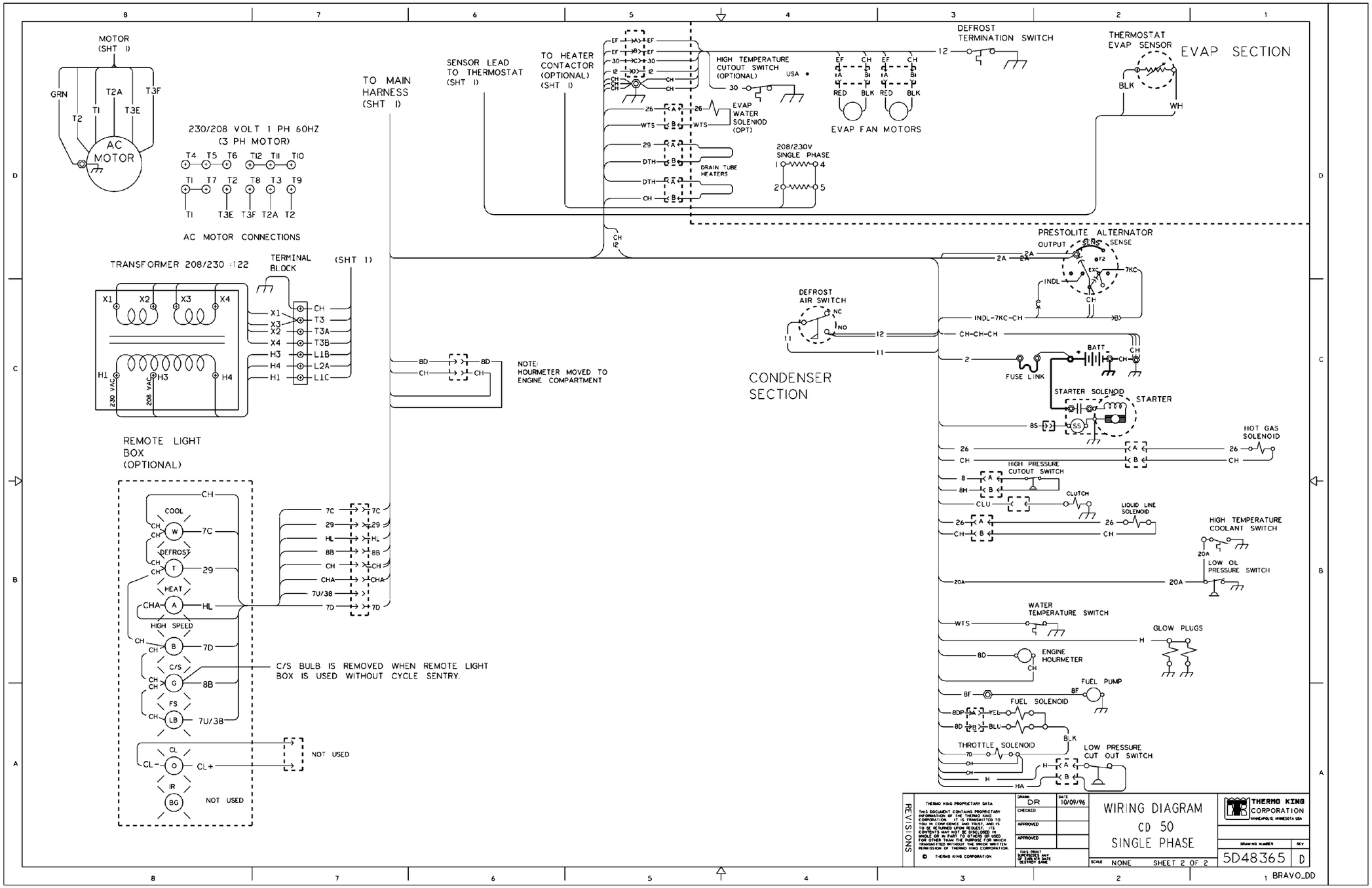
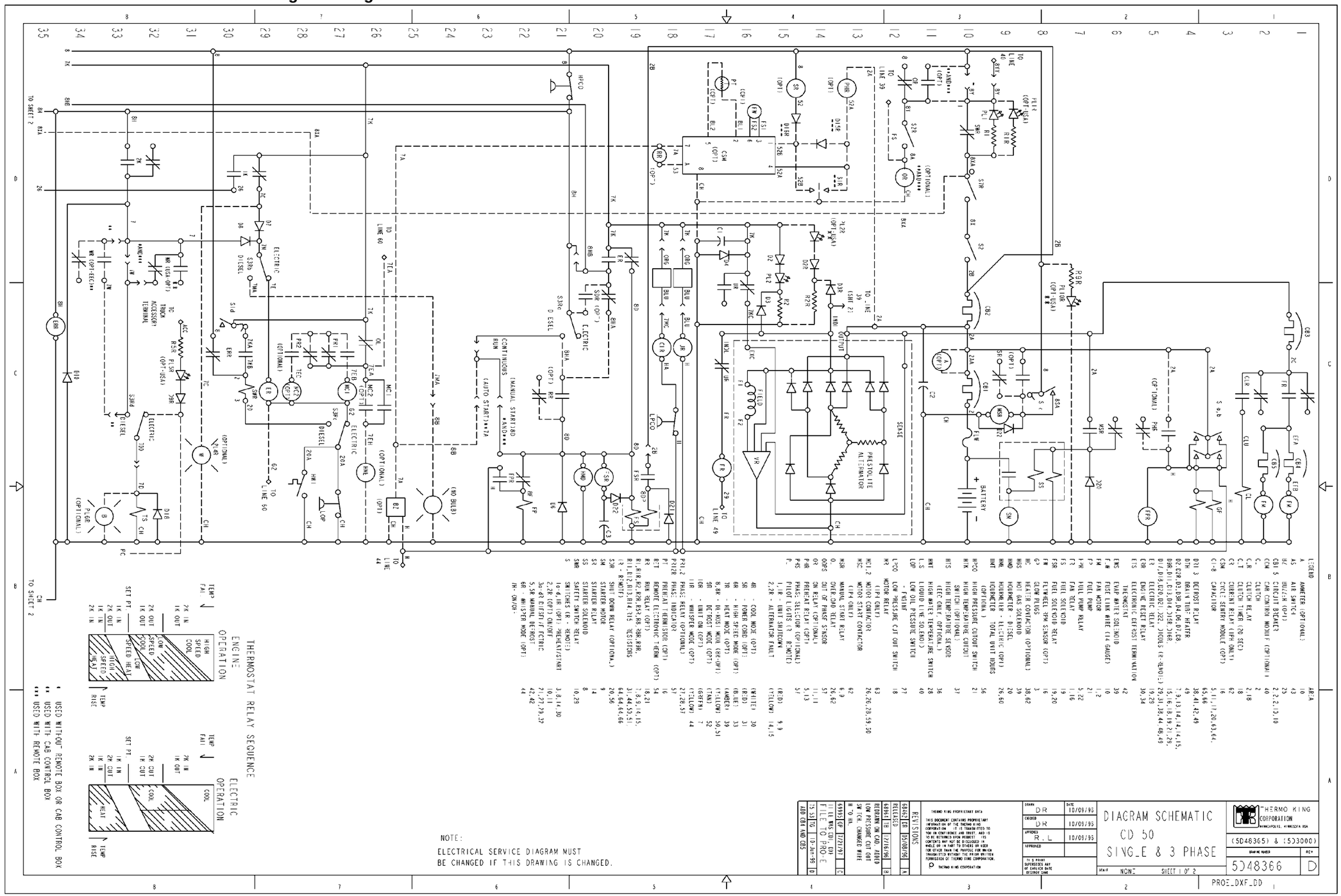


CD-II MAX 50 230/3/60 Schematic Diagram—Page 1 of 2



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